TIRES
AND
VULCANIZING

A COMPREHENSIVE AND PRACTICAL MANUAL OF RUBBER TIRES, TIRE REPAIRING AND VULCANIZING

Including all Necessary Information and Instructions on Rubber, Compounds, Cotton and Repair Materials. The Construction of Pneumatic Tires Together with Their Use, Injuries and Abuse

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PREFACE

TIRES AND VULCANIZING has been written to meet the call for a complete and accurate handbook covering the entire field of repairs to automobile, motor truck and airplane tires. The book describes in detail each operation in all the variations of application as found throughout the country. It has been arranged to meet the needs of the beginner and the expert, of tire station owners and managers and of car owners wishing a knowledge of this trade.

All of the repair methods are explained step by step and all have been selected after extensive tests in actual service. By careful application the workman will develop into the equal of any in the trade and will be able to handle all classes of work in the shop equipped with plate, cavities and kettle, together with such regular equipment as is generally found.

The man already experienced in tire repairing will find information of the greatest assistance in the further development of his skill. A great deal of new information relating to tire work and to the tire business has been gathered and is logically presented.

The author has been actively engaged in this trade for years, both at the bench and while making installations of all kinds of equipment. During later years he has trained hundreds of tire repair men, both for regular work and for the Army. All of the experience and methods found best have been embodied in this volume in such a manner as to form an everyday working guide and practical instructor for all those engaged in any branch of the tire repair business.

THE AUTHOR.

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TIRES AND VULCANIZING

CHAPTER I

RUBBER, COMPOUNDS AND COTTON

RUBBER

Tires are made from rubber, compounds and cotton. These materials are manipulated by hand or machinery and combined into the structure of the pneumatic tire. A study of them will enable one to more fully understand the use, repair and vulcanization of tires and other rubber goods.

Many different kinds and qualities of rubber are found in or near tropical countries. It comes from shrubs, vines and trees of great height. Rubber plants or trees that are producing caoutchouc (rubber) are found in Brazil, Peru, Bolivia, Southern Mexico, South and Central America, Africa, Ceylon, the Malay Peninsula, the East Indies, Borneo, Java, Sumatra, and in other territories in smaller quantities.

The rubber is transported to the dealer or the factory in various forms or shapes, which, in most cases, depend on the territory from which the rubber comes. Such forms are known as knuckles, negro heads, balls, thimbles, nuts, tongues, loaves, biscuits, crepe sheet, or crude.

Each territory may have several grades of rubber,

running either to a fine or coarse selection and also varying in the color and grade of gum. An example is found in Brazilian rubber (para), which may be of several grades. Coarse para is usually noted by the condition in which the rubber is collected and

Figure 1.—Crude rubber biscuits.

reaches the market. Fine para, coming from plantations and properly handled, is of a better grade and free from bark, shrub and dirt. Caucho ball is another inferior grade of para rubber from the same locality.

Para rubber is of a dark color, while East India rubber is lighter. Some of the grades used commercially are, "first latex crepe," "thin brown crepe," "thick brown crepe," and "ribbed smoked sheets." The "first latex" East India rubber is very light in color and is somewhat similar to Ceylon, which is used extensively in making thin goods of light color. Benguella is a grade of African rubber, wild, of inferior quality, and dark in color.

Rubber itself is a chemical compound of carbon and hydrogen ($C_{10}H_{16}$). The average specific gravity of pure and commercial rubber is .910, which is of interest to the repairman, as the addition of compounds to rubber increases this weight in relation to water at 1.000, after which the rubber ceases to float.

The rubber in most common use and of the best quality is that known as up-river para, a gum containing only from two to four per cent of resin, and which, when washed in the factory, loses only from fifteen to twenty per cent of its weight. In many other rubbers the loss is from fifteen to forty per cent. Up-river para was originally found in the upper Amazon regions and in the Brazilian plateaus. Since its desirable qualities were discovered, planters in other countries, such as Ceylon and the Malay Peninsula, have been making a specialty of planting these trees. Most rubber was formerly gathered from trees which grew wild, but now most of it comes from cultivated plantations.

The Heava trees can be tapped at the age of four years, although other varieties will bear earlier. Contrary to general belief, the latex, as the fluid is called, is not the sap of the rubber tree, but a fluid found in

the bark and edges of the trunk. Thus, when a tree is tapped, it is only the bark that is cut, and the latex gradually runs from the wound, resembling milk and containing from fifty-five to eighty-eight per cent water, according to the grade. It takes approximately twenty-six gallons of latex or sap to make twenty-five pounds of rubber.

Figure 2.—Drying rubber.

There are three common ways of tapping a tree; the herringbone, the half herringbone, and the basal. The latex is then gathered and taken to the coagulat-

ing rooms; for, as it comes from the plant, the milky white fluid hardens quickly. In the uncultivated regions, the natives dip a stick into the fluid and, by holding it over a fire built of certain palms, dry and smoke it at the same time, adding layer after layer until a large ball is formed.

The planters, however, do otherwise, as their output is too large to be handled in that way. They first pour the latex into shallow pans, adding a certain amount of acetic acid to hasten coagulation. Then, when sufficiently hard, the rubber is taken to the drying room and there allowed to dry until all moisture is gone. This may take several weeks. The sheet is finally taken to a large smoke-filled room and smoked. This smoking not only preserves the rubber but improves the quality.

Rubber is sometimes sent to the factory in a crude, unwashed state. The forms usually coming from the plantation are loaves, biscuits, crepe sheet and crude. Crepe and smoked rubber should be well dried before shipment, as should the cases or boxes in which it is packed. When placed in storage or when shipped, ventilation should be provided, so that air can pass through and around the cases. A dry room or bin is advisable in order to keep moisture from the raw rubber, thus preventing it from becoming mouldy or sticky. Upon arrival at the factory, the rubber is cut up, broken down, and washed; unless it should happen to come in smoked sheets which are, as a rule, clean.

Breaking and Washing.—At the factory, the rubber is first cut and placed in warm water, then broken down by rollers. The washing machine consists of two grooved rollers working opposite each other. One

roll is larger and revolves at a greater speed than the other in order to tear the rubber down and remove the impurities. A stream of water is constantly flowing over the rubber to wash away the dirt as fast as relieved, and also to keep the rollers from getting hot from the friction of the rubber as it goes through the mill.

Figure 3.—Washing rubber.

From the washing machine the rubber is taken to a pair of smooth or corrugated rollers and pressed into thin sheets so that it will dry quickly. Drying,

at the best, generally requires several weeks. The sheets are usually hung in a room heated to a constant temperature by a stream of warm air. There are several other methods of drying, but this is the one mostly used.

Mastication.—The object of this operation is to

Figure 4.—Rubber mixing mills.

knead the rubber as it comes from the drying room until soft enough to allow the introduction of the various compounds used in vulcanizing. The mills are similar to the washing mills, except that the rollers

are hollow to allow steam to pass through them. Cold water can be forced in, should the friction of the rubber on the rolls make the mass sticky. From here the rubber goes to the mixing mills.

Mixing Mills.—These rolls are also similar to those for washing, except that there is a tray under them to catch the compounds that do not at once imbed into the rubber. The operator adjusts the rolls so that the sheet of rubber is just too thick to go between them, and, as a result, the rubber masses itself at the junction of the rolls. The rolls are heated to a temperature such that one can just hold his hands on them.

The correct quantities of rubber, sulphur, and other compounds are made ready, and the mixing is done by allowing the rubber to run evenly around the roll, then adding the sulphur evenly and slowly until completely worked in. Compounds are then added in the same way, after which the mixture can be cut off the roll and run through it the other direction to properly distribute the compounds. This is continued until the mix has been properly rolled. After mixing fully with the required compounds, a strip is cut off and taken to the testing room, where it is cured and tested for the various qualities desired.

Calendering.—This is done in a large rolling mill having three steam heated rolls which are adjustable for any thickness desired, and which all run at the same speed. Calenders used for frictioning fabric are similar, except that the center roll revolves faster than the top or bottom rolls in order to give the friction to the fabric. When using the calender, the rolls are, like those of the mixing mill, heated to a tem-

perature in accordance with the kind of compounded rubber that is to be worked. Gums used commercially are then sheeted to a thickness depending on the use to which they will be put.

Fabrics are frictioned first, then skim-coated with the frictioning gum or compounded rubber to suit them for the use intended. These fabrics can be cut into strips of the necessary width, either on the bias or straight, by the use of an attachment on the calen-

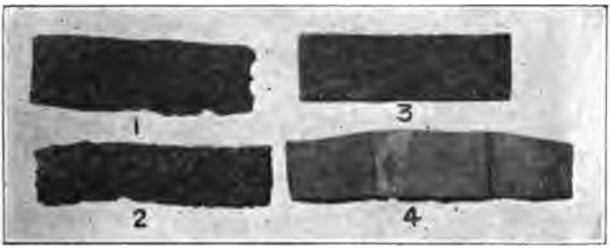


Figure 5.—Para rubber. 1—fine para crepe. 2—coarse washed para. 3—ribbed smoked sheet. 4—compounded tread.

der. After cutting, the gums or fabric are rolled with a cloth or holland backing ready for shipment and use.

The foregoing describes, in a general way, rubber and its manipulation as prepared for use in connection with pneumatic or solid tires.

COMPOUNDS

As rubber itself is not a substance that will stand wear or abuse, it must, therefore, be compounded. The addition of compounds to rubber and the heating of the mass causes a change in the physical characteristics. This change will, according to the kind of com-

pound used, add a finish, add temper, hasten a cure, or obtain a color or other result required from the individual mix, while at the same time lessening the cost of the product and retaining the properties of rubber itself. The compounds are classified according to the results that they will produce, namely:

Figure 6.—The calender.

Hastening or quick cure compounds (accelerators) to decrease curing time.

Hardening or tempering compounds to increase the wearing life.

Softening compounds to increase resiliency.

Filler compounds to add volume and decrease the cost; also for wear.

Resistance compounds and oils to add life to the rubber and protect it while in use.

Pigments used for coloring.

The compound most essential for the vulcanization of rubber is sulphur, which may run in quantity from two to as high as ten per cent, according to the uses of the mix. Endeavors have been made to provide a substitute for sulphur, but at this time none has been found practical for general use. The low cost of sulphur still makes it the leading agent for causing vulcanization.

The following is a list of compounds generally known and used in compounding rubber for various uses:

Aluminum Flake.—An inert heat resistant which toughens rubber.

Antimony Sulphide (Red or Orange).—Pigment used in coloring rubber.

Asbestos.—Low conductivity of heat makes it valuable in steam packing.

Asphaltum.—A softening compound; retards blooming, limits oxidation and increases density.

Atmido.—A snow-white filler of low specific gravity and indifferent to acids. Used in small portions to increase strength and resiliency in soft rubber goods. Also used in larger portions to make hard compounds and to resist superheated steam.

Barytes.—Heavy white filler material, which increases resistance and adds weight. Also a pigment for white rubber goods.

Blue Lead.—Cheap heavy filler often displacing barytes. Produces a black color.

Borate of Zinc.—A white pigment occasionally used.

Burnt Umber.—Dark brown pigment; inert, and a good filler. Often used in brown and maroon goods.

Calomel.—Used to hasten vulcanization.

Carbonate of Calcium.—Whiting, used only as a filler.

Charcoal, Animal.—Made from bones; absorbs odors and is used in packing to withstand heat.

Charcoal, Vegetable.—Made from burnt wood; used in certain vulcanite and insulated wire compounds.

Cork.—Used in rubber as a binding material. At one time used with rubber to make it waterproof. Also used to resist heat.

Emery.—Used in the manufacture of vulcanite wheels.

Fire Clay.—Mixed with rubber and dissolved in tar, oil and sulphur. Forms a compound which, when applied to hot joints, cures at once.

French Talc.—Ground and sifted to be used for tire lubricant.

Lamp Black.—Inert and used as a pigment for black rubber.

Lime (Air Slacked).—Used in small quantities to increase hardness and decrease curing time.

Litharge.—A lead compound valuable as a filler. Also hastens curing to a marked degree. Delivers a degree of hardness.

Lithopone.—A pigment used when white rubber is desired.

Magnesia.—Increases toughness and resilience. Also hastens and increases hardness.

Manganese.—Use to hasten vulcanization of rubber used in cements.

Mercury Sulphide.—A pigment used for red rubber goods.

Oils.—Castor, linseed, and rape oils are used as fillers.

Plumbago.—Sometimes called black lead, less combustible than most ingredients and therefore used in articles capable of withstanding great heat. Inert.

Powaered Chalk.—Used as a filler.

Powdered Coal.—Cheapest for making jet-black, semi-hard rubber.

Rubber Waste.—Used as a filler after being reclaimed.

Soapstone.—Used in place of talc to keep rubber surfaces from sticking. Also as an adulterant.

Sulphide of Lead.—Used as a black pigment and also for resiliency.

Sulphur.—Without which rubber cannot be vulcanized.

Sulphur runs from two to ten percent in rubber compounding.

Whiting.—Made from English chalk. Used more extensively than any other compound except sulphur. Increases hardness.

Zinc Oxide.—Used to a large extent in compounding white rubber goods, also for tempering rubber.

There are altogether about two hundred different compounding materials, each having its individual use for the manufacturer. The following are some of the less known or used; aluminite, asphalt, camphor, clay, fossil flour, gelatine, graphite, leather waste, paraffine, pitch, pumice, sawdust, sand, shellac, slate, starch, tar, varnish, wheat flour and white lead. Other colors are yale blue, saxon blue, chrome yellow and chrome green.

Compounds mixed with rubber for use in the manufacture of the original tire vary somewhat from those used in the repair materials, as the time of cure is usually cut down when making the repair. The assembling of rubber with the compounds in batches or mixes for various uses is done at the factory by experienced laboratory men who, ordinarily, are the only ones who know just what compounds are used or what quantity is added. Every use requires a different formula, as is shown by some of the following compounds used with rubber. The percentages given are approximate:

Original Tread Stock (White).—Usually composed of smoked sheet 45%, sulphur 4%, magnesia 2%, lithopone, 25%, zinc 24%.

Repair Tread Gums (White).—Smoked sheet 30%, reclaimed rubber 15%, sulphur 4%, barytes 20%, magnesia 4%, zinc 25%, lime, 1 to 2%.

Cushion Gum.—Smoked sheet 75%, sulphur 4%, litharge 2%, barytes 14%.

Tube Repair Gum.—Smoked sheet 45%, reclaimed rubber 20%, sulphur 6%, litharge 2%, zinc 27%.

Tube Stock.—Smoked sheet 80 to 90%, sulphur 1½ to 2%, antimony 15% when used in red tubes.

Solid Tire Stock.—Rubber 40%, reclaimed rubber 10%, sulphur 6%, zinc 20%, litharge 10%, aluminum flake 14%.

Rubber, when crude, will get sticky or soft in time, hence the reason for vulcanization which will make the ingredients unaffected by temperatures ranging from zero up to 195 degrees. It is up to this point that crude rubber begins to soften and flow, according to the compounds used. There are many kinds of vulcanization which take place through the application of heat, acids, or vapor to the rubber. These can be classified and grouped as follows:

Hot Cure.—Dry; in which the live steam does not touch the rubber. Wet; in which the article is placed in live steam.

Acid Cure.—Dipped method; in which the article is submerged for a short time in carbon-disulphide and chloride of sulphur or in other acids. This is used mostly for thin rubber goods.

Vapor Cure.—Made by placing thin rubber goods in a heated cabinet or room and allowing the infusion of chloride of sulphur vapor around the article for a period of time.

The above methods will be fully explained later in connection with the various kinds of work.

It should be remembered that all vulcanizing operations consist of the use of a proper container for holding or securing absolute pressure, necessary heat and correct time of cure as applied to the compounded rubber.

COTTON AND FABRICS

Cotton countries, like rubber countries, are located in the warm territories on both sides of the equator. However, they extend farther toward the temperate zones. Cotton requires a warm climate and proper ground conditions in order to thrive. A country low in altitude gives the better cotton.

White Sea Island cotton is a high grade long fibre cotton, the staple averaging about 1¾ inches in length. It is rated as a leading standard cotton for tire fabrics. The seed from which this cotton is grown was originally imported from the Bahama Islands and planted on the low islands along the coasts of Georgia, South Carolina, and Florida. It is a light colored cotton of extra long and strong fibre.

Egyptian cotton is used to a large extent in the manufacture of tire fabrics, being raised along the Nile in Egypt and shipped into the cotton mills for spinning and weaving. It is also raised in certain localities of the United States and in Brazil from imported seeds. A quantity of short fibre will be found in Egyptian cotton.

Domestic cottons consist of several grades, varying from a medium to a long staple cotton. The Orleans, Texas and Mobile, Peelers, and Benders grades constitute those which are raised in Southern States from domestic crops. Among other grades are the Pima and Yuma cottons of Arizona, being originally grown from imported Egyptian seeds, and having a staple about 1½ inches long. Durango cotton comes from California, having a staple of about 1¼ inches. The Mississippi Delta grows a medium short staple cotton of about 1 inch, which is termed Delta cotton.

All cotton is graded according to the condition or strength and length of the fibre and is sent in bales to the factories, where it is picked, carded, combed and drawn for spinning into the proper thread required by the tire manufacturer for his fabrics. The cotton is then made into square woven fabric of different weights, or is connected by cross threads

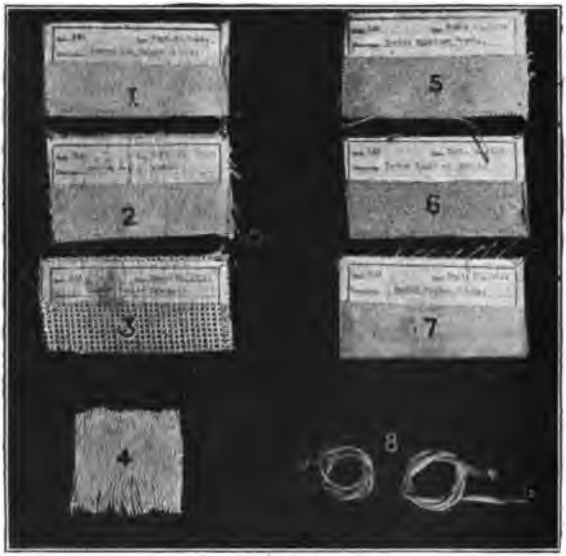


Figure 7.—Cotton fabrics. 1—combed sea island. 2—combed peeler. 3—combed peeler. 4—cord fabric. 5—carded egyptian. 7—combed peeler. 8—cable cords.

for use in a patent weave cord fabric. In the cord fabric, a spun cord of heavier weight is used. In some cases cotton is sent to tire factories to be twisted into heavy cords for the cable cord tire.

In all cases the material is inspected, bleached, washed, and dried and is accepted to be without blemish by the tire manufacturer. It is examined for tensile strength, exact weave, weight per square yard, and quality of fibre, being passed over lights to find defects.

Some of the grades used by the tire manufacturers are as follows:

Combed Sea Island Cotton Fabric, for building fabrics, cord fabric, and cable cords.

Combed Egyptian Fabric, used for the same purposes, also bead covers, etc.

Combed Peeler Fabrics, used for the same purposes, bead covers, etc.

Carded Egyptian Fabrics, used for the same purposes, bead covers, etc.

Combed Peeler Fabrics, used for breaker fabric.

No great quantity of Sea Island cotton is used; Egyptian and domestic cotton in long or medium staple being commonly employed.

Square woven fabric for building in the tire runs from sixteen to seventeen and one-half ounces per square yard. Cord fabric is usually lighter, running from thirteen to fifteen ounces per square yard, although some tire manufacturers are making a heavier cord fabric. In the square woven fabric the cords or threads cross each other at right angles. In the cord fabric tire the cords are parallel and imbedded in the friction so that they do not touch. They are connected by small cross threads which hold them in place until on the tire. The cable cord is twisted and placed in the tire in the same manner as the cord fabric, namely, parallel. The cable cord has

no cross thread and the friction stock is impregnated throughout the cord.

The frictioning of rubber stock to fabrics is handled in somewhat the same manner as the process of calendering gums. The calender operates under the same method; but, as stated before, the center roll runs faster than the two outside rolls, this being the means of applying the friction material. The upper and lower rolls are hot to a point of sizzling, with the center roll somewhat cooler. The center roll is sheeted with rubber. The fabric or cord fabric is run through the rolls and the friction stock forced into the material, as it leaves the center roll and imbeds into the meshes of the fabrics.

Fabrics for various uses are skim coated after frictioning and are handled in the same method as when frictioned, except that the rolls are cooled and the center and lower rolls run at the same speed. The rolls are set to allow for the proper thickness of the skim coat, and the frictioned fabric is started through.

CHAPTER II

PNEUMATIC TIRES

Many kinds of pneumatic tires are on the market. However, they can all be placed in three classes; namely, fabric, cord fabric and cable cord tires. Fabric tires and cord fabric tires are similar in carcass construction, while there is a considerable difference in the construction of cable cord tires. Various differences in the bead construction and ending of the plies will be found in all kinds. It is therefore of the utmost importance that the construction of all kinds of tires be known, especially from the sectional end views of the tire.

Making Tires.—Tires are made both by machine and by hand. In the factory, all materials are tested and cut to the proper widths and lengths. They are then delivered to the builder, as the tire maker or workman is called, ready for application to the core or parts of the tire.

To build the tire, a core of iron, either in a sectional, solid or shell type, is cemented with one coat of core paint and placed on the spider or spindle of the building stand ready for application of the materials. The fabric is then applied to the core with three-fourth-inch laps at the splices and stitched down over the bead, either by hand or machine.

In hand building, one ply is added at a time, with

the splices on every other ply opposite the one placed before. A hand pulling tension is used to bring the fabric into its proper place. In machine building, two and sometimes three plies are added, the fabric

Figure 8.—Machine building.

being rolled or spun on the core from rolls and cut when the proper number of plies are placed.

The insertion of the bead varies according to the maker. Some insert the bead after two plies of fabric have been placed on the core and the additional ply is built over to the toe of the bead. Other manufac-

turers insert the bead after all the fabric has been applied.

Where the splices go over the bead, the three-fourth-inch lap is usually cut down to one-fourth inch. After the fabric plies have been built up and the bead core

Figure 9.—Finishing tires.

inserted, all surplus fabric extending over the toe of the bead is trimmed. The bead cover or chafing strip is applied, two usually being used on large size tires.

For double cure or semi-cure tires, gum strips are

applied over the line of the chafing strip. The side wall is then applied about one-fourth inch above the channel of the bead. Cover stock is added to cover the tire down to the side walls. The tire is now ready for the semi-cure and is jacketed or wrapped

Figure 10.—Vulcanizing.

before going to the kettle. After curing, the tire is stripped from the core, buffed, and the breaker and tread added for the final cure.

In full moulded or single-cure tires, the method of building is slightly different, being used mostly on small tires. The carcass is built in the same manner, but the outside stocks are heavier. The bead cover,

side walls, cushion, breaker and tread are applied before the cure.

Cord fabric tires are similar in construction to the fabric tire, being usually hand built in about the same way as hand built fabric tires. The ending of plies at the bead varies according to the manufacturer, in securing the proper strength and best arrangement. The ply is extended to lap over both the inside and outside of the side walls. This will be found on nearly all makes of cord fabric tires. A close study of the cross section will show clearly how the plies end.

Càble cord tires are built with two, three, or four plies, being made on special machines in most cases. In the two-ply cable cord, cotton thread is twisted into the proper size cable cord, being at the same time impregnated with the friction material. On Q. D. staple types, a steel core is employed, to which is attached a special ring for holding the staples. A layer of cushion is applied to the core and a layer of cords applied by a special machine with steel fingers which automatically carry the cord diagonally back and forth across the core until a complete layer is added. A ply of cushion is again added and the second ply of cords built up in a direction opposite to the first. The tire is removed and the bead is completed by the application of a split bead core. Bead covers and stiffening strips, including the side wall, breaker and tread, are applied to make the tire ready for curing.

In four-ply cable cord tires, the cotton is impregnated and twisted into cords, then rolled on a special sized drum which has a spiral slot for cutting through

the cords and which gives a single ply of sheet cords of the proper size. Two of the plies are stitched together and then applied to the core on the building machine. Bead cores are inserted, after which two more plies are applied at once. Bead covers, side walls, and tread are applied on the same machine and the tire is trimmed for curing. The ply on this type of tire ends at the toe of the bead in most cases.

Three-ply cable cords employ practically the same method of construction, being built by hand or machine, with the inside layer running directly across the core, while the two remaining plies are built on a bias to the core and diagonally to each other.

Large pneumatic truck tires are built in both cord fabric and cable cord types, the cord fabric using several plies of fabric, while the size of the cord is increased in larger cable cord tires. Clincher types can be secured in cable cord as well as in cord fabric, being used on airplanes and in Ford sizes. A soft bead core is used in this type.

Curing Tires.—Tires can be cured by moulded or wrapped methods. Dates, serial numbers, etc., are now added. In the moulded method, a complete metal mould, made in two halves, encases the tire. When the tire has been locked up for cure, it is placed in vertical or horizontal kettles which hold a number of tires, and is cured for a length of time suited to the size of tire and kinds of materials used. The length of cure varies from one to two hours, at temperatures determined by steam pressures from forty-five to sixty pounds, according to the make.

With the wrapped method, two side flanges are used which come up the side wall only. The tire is

then wrapped by machine and placed in the kettles for curing. With either method of curing, good tires can be made by proper attention to the quantities of material used and the proper workmanship.

When the tires have been cured, they are tested under pressure, trimmed, inspected, marked, and all defective tires set aside. The others are wrapped and stored for shipment.

The average pneumatic tire is composed of approximately fifty-three per cent rubber, twenty-three per cent compounds, and twenty-four per cent cotton fabric, by weight. In cost, fabric is greatest, labor and overhead expense next, rubber third, and compounds last. It is safe to say that fabric represents over fifty per cent of the cost of production. Labor and overhead make practically twenty-five per cent, due to the present cost of labor. Rubber, which has been decreasing in value in the past years, represents about twenty per cent, which leaves approximately five per cent for compounds in the present tires.

SPECIFICATIONS REQUIRED BY THE GOVERNMENT

Fabric tires, in order to be of the first class and in good condition, should carry a load determined by their size, should stand inflation to twenty pounds to the cross section inch, and should have the manufacturer's name and serial number, together with a marking as to the year and month in which made. All splices should be gum stitched and of the number of plies for that standard size. Splices should be three inches apart and stepped around the tire. Fabric ought to be domestic long fibre or Egyptian long staple, there being very little white Sea Island

cotton used, and in weight, seventeen to eighteen ounces per square yard. Chafing strip or bead cover to come up one inch on the side wall. The cushion should cover more surface than the tread. The breaker should be of a width in proportion to the size of the tire. The tread should be three-eighths of an inch thick in the center. The cross diameter of the inflated tire should be equal to the size of the tire. The tread should be composed of sixty-five per cent rubber or its equivalent in volume, eight per cent sulphur, and should have a tensile strength of over 2,000 pounds per square inch. A larger quantity of pure rubber should be used in the friction stock. Tires should be free from defects and should carry the manufacturer's guarantee. No oil substitutes to be used.

Cord tires will carry about six to seven per cent more rubber, with a slightly higher tensile strength, and with no rubber waste used. The sulphur used will be approximately the same, with no oil substitutes.

There is no set standard of materials that go into a tire by weight, every manufacturer having different ideas as to the kind of tire that will deliver the most mileage. Some use a light tread and heavy carcass, while others use a heavy tread and light carcass.

PARTS OF TIRE DEFINED

Tread and Side Wall.—The tread and side wall on the tire are composed of rubber compounded to stand wear and friction. Both are composed of the same material, but the side wall is thinner as it does not have to withstand the traction against the road surface. In rutty territories, however, the side wall gets considerable wear. The tread

and side wall constitute the covering of the tire and give protection and wearing qualities to the tire and carcass. They do not have any strength as far as resisting the air pressure is concerned. Tread designs are plain, ribbed or driving tread and non-skid. In the non-skid class, two kinds are encountered, the raised non-skid and the vacuum type. The practicability of the two types as non-skids bears greatly upon the conditions under which they are run, whether on city pavement, hard highways or country roads.

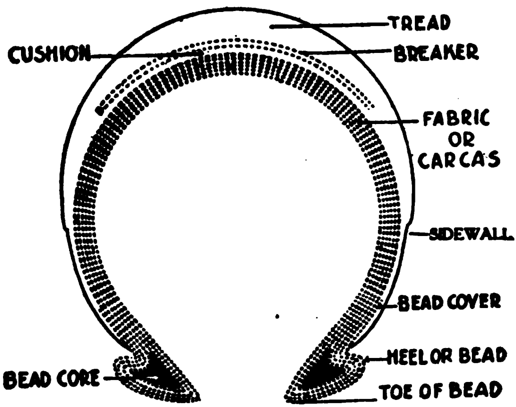


Figure 11.—Parts of the tire.

Tread Line.—The meeting of the tread at the side walls. On some moulded tires, the tread line does not show.

Breaker.—The breaker strip is composed of an open woven fabric of heavy cotton, being placed under the tread and over the cushion. The breaker takes the concussion and shocks from the outside of the tire and distributes them evenly over the carcass through the medium of the cushion. The breaker makes an even strain at the point of contact with the road or other object that the tire may encounter. This strain is distributed over approximately five to eight times the surface of the original contact. The breaker also acts as binder for the tire by stiffening the cushion and tread and by giving the tire body.

Cushion.—The cushion is placed under the breaker and

in some cases a thin layer goes over the breaker. It is a cushion or pad for the carcass of the tire. On account of the great adhesiveness of the gum the cushion forms an excellent uniting factor, acting as a binder or flux between the tread or breaker and the carcass and distributing the shock when acting with the breaker. The cushion also acts as a waterproof cover for the fabric in the tire, the moisture easily working through the compounded tread, but being held at the cushion line.

Carcass or Fabric.—The carcass forms the real strength of the tire. It is composed of layers of fabric, cord fabric, or cable cords built up to the shape and size of the tire. At the sides of the carcass are placed the beads. One-half of the layers usually come on each side of the bead core and end at the toe of the bead or heel of the bead, according to the construction, or, in some cases, on the inside or outside of the tire, as in Dunlop or cord fabric tires of recent manufacture, and in recent cable cord tires. As tires increase in size, the number of plies increase (except in cable cords), and in making repairs it is neccessary to remove sufficient plies to entirely remove the injury. Following is a table of plies in tires (approximate) according to the standard build up. A few exceptions will be found, but will not change the repair work to any degree.

PLIES FOUND IN TIRES

Common Fabric			*Cord Fabric*		
3″	Motor Cycle	3 ply	3½″	has	5-6 ply
3″	Regular	3-4 "	4″	"	6 ply
3½″	Regular	4-5 "	4½″	"	7 ply
4″	Regular	5-6 "	5″	"	7-8 ply
4½″	Regular	6 "	5½″	"	8 ply
5″	Regular	6-7 "	6″	Goody	10 ply
5½″	Regular	7 "	7″	"	10 ply
			8″	"	12 ply
			9″	"	14 ply

Aeroplane	*Cable Cord*
3″ fabric 4 ply	2 ply
4″ Cd " 4 ply	3 ply
5″ Cd " 6 ply	4 ply

Some cord fabric tires have approximately the same number of plies as fabric tires; others will carry more plies, being of a finer cord fabric.

Bead Cover.—Sometimes called the chafing strip, is a thin fabric, usually about eight ounce, which in most tires runs from the toe of the bead over the heel and up the side wall from one to one and one-half inches. On smaller tires only one ply is used, while on large tires two plies are used, and in heavy duty tires two plies of heavier bead cover are used. On some tires the cover continues inside the tire.

Exceptions will be found in which no bead cover is used. This is important to know when removing a bead cover or in providing for it when none is used. The principal use of a bead cover is to prevent chafing of the iron rim against the fabric itself and also to give the bead a finish.

Neck or Bead Channel.—This is the connecting point for the layers of fabric when they meet after coming around the bead core. At this point there is considerable play in the tire and reference is made later as to the procedure on repairs at this place.

Heel of Bead.—The bead heel is that part of the bead away from the tube and which, on Q. D. or S. S. tires, fits into the rim channel. The vulcanizer will have considerable to do with the heel of bead as the cutting out and ending of the ply is made at this point.

Toe of Bead.—The toe of the bead is the point of the bead against the tube when in the case. It is of greater importance than the heel in cutting and ending plies on cut-down or build-up.

Bead Core.—This is the nucleus of the bead as a whole. Usually composed of heavily compounded rubber or wire cable for holding the strength and shape of the bead.

False Beads.—Many manufacturers make S. S. tires and add a false bead for the Q. D. type, there being only a bead cover holding the false bead in place.

Stiffening Strip.—Used mostly on cable cord tires over the staples.

Anchor Strip.—A medium heavy fabric surrounding the

bead core and running up between the split plies. In heavy cord tires two-ply is used.

Note: Other parts will be encountered, especially in puncture-proof tires and the like. These will automatically take care of themselves, because, in most cases, metal parts are not replaced in the repair, but are thrown away.

Figure 12.—Types of tires. 1—quick detachable. 2—regular clincher.

TYPES OF TIRES

The type of tire relates to the bead construction for use on rims. There are three distinct pneumatic types in use. The regular clincher (soft bead), has an expandable hard rubber core built slightly smaller than the wheel or rim for which the size is made. This bead type is usually forced over an endless rim (Ford types), the bead coming back under the flanges when the whole tire is on.

The quick detachable bead is similar to the soft bead clincher type except that a non-stretchable rubber core is used and sometimes a wire cable. This type of bead requires the removal of a side flange on the rim or a split rim for set-up.

The straight side bead is made for straight side rims and is non-stretchable, the rim being split or one side flange being removable. The straight side type is the one now mostly in use and will no doubt take the place of all Q. D. types, having been found practical for any and all uses.

Straight side tires have been found to give better mileage than clincher or Q. D., due to more air pres-

Figure 13.—Straight side tire.

sure in contact with the rim and which holds the tire up directly. This is said to have considerable bearing on the present increase of standard tire guarantees from 3,500 to 6,000 miles. Most sizes are to be made in the future only in a straight side type.

TIRE SIZES

The present pneumatic tire is made in standard sizes of an air capacity sufficient for its intended use to carry a specified weight on cars or trucks. In all

cases a tire may be constructed to fit the same size greater load, in which case we have the dimensions giving the oversize.

Carrying a greater load than was originally intended for the tire or car results the same as under-inflation, just as if the air were allowed to go down under the regular weight. An oversize will cause less strain on the engine, will give easier riding, and should increase the mileage due to less strain on the

Figure 14.—A tire and its oversize.

tires. This is especially true on rear wheels, as the greater strain comes on them when driving.

Regular size tires were not made to carry the oversize load, and it is at that point that tires must be oversized to secure proper mileage, as the oversize is constructed to hold more air and is therefore made larger, with additional fabric or cord fabric. In the cable cord only the size of cord and the capacity increase. It must be remembered at all times that

the load is actually carried on air and that the tube is only encased to hold the air.

In order to designate the regular and oversize of a pneumatic tire it should be understood that the measurements cover two dimensions; the complete diameter of the tire from the outside point of the tread, and the height of the cross section of the tire from the top of the tread to the toe of the bead. This is approximate, as, for example, a 34″x4″ tire means that it is 34 inches across the complete tire to the outside tread or surface (first cure) and that it is four inches from the top of the tread to the toe of the bead in the cross section. Should you deduct the depth of the two cross sections, which would be eight inches in this case, from the complete diameter of the tire, you would have the rim size; or, in this case, a twenty-six-inch rim or wheel. An oversize for this tire would be found by adding one-half inch to each cross section on the outside of the tire to take care of the additional fabric and air space. This would make the cross section four and one-half inches. You have added one-half inch on each side of the tire, or one inch for the complete diameter, making the complete diameter thirty-five inches, or the oversize a 35″x4½″. You have not changed the size of the wheel or rim, for, by taking nine inches from the thirty-five inches, you still have twenty-six inches for the rim or bead size. By measuring this size, these measurements will be found correct.

In determining the correct oversize which corresponds to any given regular tire it is only necessary to add one-half inch to the cross section and to add one inch to the over-all diameter of the tire.

PNEUMATIC REGULAR AND OVERSIZES

(Showing Load to Be Carried.)

Regular Size	*Over-size*	*Load*
28x3	29x3½	375 lbs.
30x3	31x3½	375 lbs.
32x3	33x3½	375 lbs.
30x3½	31x4	570 lbs.
32x3½	33x4	570 lbs.
32x4	33x4½	815 lbs.
34x4	35x4½	815 lbs.
35x4	36x4½	815 lbs.
36x4	37x4½	815 lbs.
32x4½	33x5	1100 lbs.
34x4½	35x5	1100 lbs.
36x4½	37x5	1100 lbs.
34x5	36x6	1200 lbs.
36x5	37x5½	1300 lbs.
36x6	38x7	2000 lbs.
38x7	40x8	2720 lbs.
40x8	42x9	3670 lbs.

The above load capacity is for the regular size. The oversize capacity may be secured by noting the oversize cross section and referring to the oversize in the regular size weight.

In the heavy duty types, 36″x6″, 38″x7″, and 40″x8″, a double oversize is apparent and this can be used by increasing the width of wheel or rim.

The oversize tire will, in most cases, deliver more mileage on the regular size load than represented by the difference in cost. Most regular size tires are now being oversized by the manufacturer in clincher bodies and give more mileage than would be expected under a straight regular size.

Practical sizes of heavy duty tires now in use are

the 36″x6″, 38″x7″, 40″x8″, and 42″x9″, although larger sizes up to 54″x15″ are being tested out for use.

All these large tires have a standard twenty-four-inch wheel size, which allows the advantage of placing the oversize by changing only the rim to accommodate the tire. On the regular size rim, the next oversize can be placed thus: a 36″x6″ rim takes 36″x6″ and 38″x7″; a 38″x7″ rim takes 38″x7″ and 40″x8″; a 40″x8″ rim takes 40″x8″ and 42″x9″, and so on up.

If heavy duty tires are used under the proper weight on trucks, unlimited service can be secured providing proper care and attention are given the tire. Mileage running from 8,000 to as high as 25,000 is being secured in some cases.

The adjustment basis on heavy duty tires does not necessarily mean a specific mileage guarantee. The manufacturer may guarantee 3,500 or 5,000 miles and then use as high as 8,000 to 12,000 miles as a fair basis for adjustment consideration provided defects occur under ordinary road and weight conditions.

From 90 to 130 pounds pressure has been found from actual tests to give the best service on heavy duty tires when used under the recommended weights, thus:

36″x6″, inflate to 100 pounds.
38″x7″, inflate to 110 pounds.
40″x8″, inflate to 120 pounds.
42″x9″, inflate to 130 pounds.
44″x10″ inflate to 140 pounds.

Heavy duty sizes are made for certain recommended loads, thus:

36″x6″ tires give good service on ½ to ¾ ton trucks.
38″x7″ tires give good service on 1 ton trucks.
40″x8″ tires give good service on 1½ to 2-ton trucks.
42″x9″ tires give good service on 2½-ton trucks.
44″x10″ tires give good service on 3½-ton trucks.

Larger sizes of these tires are being tested for use on trucks up to five-ton, where they will replace solid tires and decrease road shocks, consumption of gasoline, and wear on the truck. The average life of the truck is calculated to be from two to two and one-half times greater when equipped with pneumatic tires. Easier riding and faster transportation is also secured. If a change from solid to pneumatic tires is to be made, the work can be done by any good wheelwright in a few hours.

To arrive at the load on the front and rear wheels it is only necessary to drive the front wheels on a scale and then the rear wheels. One-half of each weight will give the approximate weight per wheel. The end of the car which is off the scales should be level with the other.

Single heavy duty pneumatics are used up to two-ton capacity on trucks. Over this weight, either dual pneumatic or solids are used.

A large number of the present pneumatic tire sizes are being discontinued and all tire manufacturers are standardizing on only a sufficient range of sizes to take care of the car equipment. The following table shows sizes as they will be used or continued by most manufacturers:

1919 and 1920 output				Continued after 1920			
Plain or Ribbed		*Non-Skid*		*Plain or Ribbed*		*Non-Skid*	
30″x3″	Cl	30″x3″	Cl				
30″x3½″	Cl	30″x3½″	Cl	30″x3½″	Cl	30″x3½″	Cl
31″x4″	Cl	31″x4″	Cl	31″x4″	Cl	31″x4″	Cl
32″x3½″	SS	32″x3½″	SS	32″x3½″	SS	32″x3½″	SS
32″x4″	SS	32″x4″	SS				
33″x4″	SS	33″x4″	SS	33″x4″	SS	33″x4″	SS
34″x4″	SS	34″x4″	SS				
32″x4½″	SS	32″x4½″	SS				
33″x4½″	SS	33″x4½″	SS				
34″x4½″	SS	34″x4½″	SS	34″x4½″	SS	34″x4½″	SS
35″x4½″	SS	35″x4½″	SS				
36″x4½″	SS	36″x4½″	SS				
33″x5″	SS	33″x5″	SS				
35″x5″	SS	35″x5″	SS	35″x5″	SS	35″x5″	SS
37″x5″	SS	37″x5″	SS				
		36″x6″	SS			36″x6″	SS
		38″x7″	SS			38″x7″	SS
		40″x8″	SS			40″x8″	SS
		42″x9″	SS				

All sizes so far listed have dealt with the American rim contours. Millimeter or metric sizes are used for foreign cars, the sizes being different for interchanging. However, for comparison, the metric sizes are shown below, being for two-cure tires. Metric or millimeter sizes, compared with the approximate American size, will carry the same load to the cross section inch, and the American size is multiplied or the millimeter size divided, as the case may be, by 25.4 to arrive at the approximate size in the other.

Standard American	*Metric*	*Standard American*	*Metric*
28"x3"	700x80	32"x4"	815x105
30"x3"	750x80	34"x4"	875x105
30"x3½"	760x90	36"x4"	915x105
32"x3½"	810x90	32"x4½"	820x120
34"x3½"	870x90	33"x4½"	850x120
36"x3½"	910x90	34"x4½"	880x120
30"x4"	765x105	36"x4½"	920x120

All other sizes can be figured when required.

In many cases it becomes necessary to know the size and kind of tire used on a car when only the make and model of the car are available. For this purpose a list of car tire sizes should be secured, this list showing the size of all tires used on any make of car. These lists may be had from publishers of tire rate books, being issued at frequent intervals to cover both new and obsolete cars.

CHAPTER III

TIRE INJURY, ABUSE, AND ADJUSTMENTS

The repairman should not only be able to distinguish the cause of any injury to a tire, but should also understand the difference between an injury and a defect from the manufacturer's standpoint. Knowing this, his trade will immediately accept him as an authority, qualified and able to inspect their tires in all cases before taking them to the tire store or sending them to the manufacturer.

A two-fold object is attained when this is done. First: if the tire is not defective and is repairable, the work can be secured and expense and trouble avoided. Second: the customer will know on what grounds he is entitled to an adjustment and can bring the matter to the attention of the seller. It requires a thorough understanding on the part of the repairman to be able to do this with justice to both customer and the manufacturer. The maker is not going to adjust an abused tire for a buyer of single tires unless it shows a defect, and the customer should know this.

In making an inspection of a tire, if a defect occurs due to faulty workmanship or material, and the tire is actually put out of service below the guaranteed mileage, an adjustment is due the customer on

the unrun mileage of the tire. A tire may show a defect and still, in many cases, be serviceable to the extent of over-running the guarantee. This tire is not adjustable on merit, but may be adjusted on policy. No tire manufacturer guarantees his tires to run a mile, the guarantee being that a certain mileage will be considered as a basis for figuring the adjustment, providing the tire was put out of service on account of a defect in workmanship or material.

All tire manufacturers do not adjust their tires on the same mileage basis. Some specify 3,500 miles, some 4,000 miles, others 6,000 miles, and tires having an adjustment base of 7,500, or as high as 10,000 miles are available. However, this should not be taken to mean that the tires are guaranteed to run that mileage. Most 3,500 mile casings have been increased to a 6,000 mile guarantee on fabric tires and 8,000 miles on cords. Some makers do not specify any mileage, the adjustment basis being made on the general condition of the tire and on defects or conditions shown below a certain mileage. In other words, a term of satisfaction is used in place of mileage.

Again, the mileage guarantee of a tire should not be taken to denote the quality, it being only the basis used by the maker for adjustments provided the tire was put out of service due to a defeet and not from injury or abuse, and within the period designated. It can ordinarily be stated that a defect of material or workmanship will show up on a tire between the first and second thousand miles use, and should no defect appear up to this time, with proper care and attention, the tire will probably run until worn out

in service. The following guarantee is used by most manufacturers:

Copy of Guarantee.—"All pneumatic automobile tires bearing our name and serial number are guaranteed to be free from imperfections in material and workmanship. Under this guarantee, tires returned for replacement will be accepted only when all transportation charges are prepaid. If, upon examination, it is concluded that the tires are defective, we will repair or replace them at our option.

For tires replaced by us, charges will be made to the owners at the time new tires are delivered, for such amounts as in our judgment will compensate for the service rendered by such replaced tires. Tires worn out in usual or unusual service, abused knowingly or unknowingly, misused, used on rims, not bearing (certain specified) stamps, or injured through accident or design, are not covered by this guarantee.

Our tires are not guaranteed (or are guaranteed) to give any specific (or for so many) miles of services, and any and all guarantees are expressly waived by any purchaser of these tires who uses in them any substitute for air, or uses them under weights in excess of those for which the various tires are recommended, or does not keep them inflated to the pressure recommended by us."

No reliable repairman will knowingly state that tires are guaranteed to run any specific mileage. He should educate the trade on the exact meaning of a tire guarantee, both for his own prestige and for increase in the volume of repair work that is sent in for adjustment when nothing is due. In many cases, adjustment is refused and the repair work is lost. The repairman is in a position to state the truth in regard to the tire situation from any angle, providing he knows his trade. Any abuse, knowingly or unknowingly, will eliminate a claim for adjustment, and any injury or abuse in the following list can be considered as work for the repairman, and not due for any consideration from the factory.

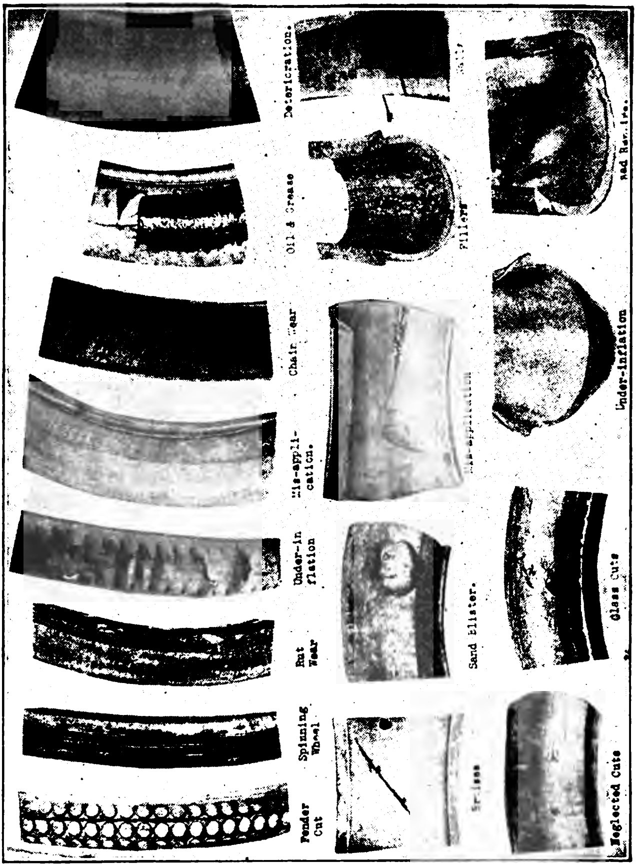


Figure 15.—Tire injuries and abuses.

INJURIES AND ABUSE

INJURY OR ABUSE	RESULT	REPAIR MADE
Alignment	Worn treads or spots caused by grinding the rubber off in a short time at the center of the tire due to the sliding action of the wheel. The misalignment may be due to a warped wheel or to hub trouble, also to improper tightening of rim lugs.	Retread if not worn through the ply or separated.
Bad Repairs	Which loosen and cause friction, then later loose fabric and tread from water and dirt working in. A blow-out results.	Replace the repair if the tire will stand it.
Blocking	Loose and worn treads due to vibration against the block, when shipping the car, and then used on the road.	Tread patch or tread section, as may be required.
Blown Sidewall	See *Leaky Tube.*	
Brake Abuse	Quick setting of brakes loosens the tread, tears the rubber, and causes separated fabric on account of the strain in scraping on the ground at one or two points.	Retread, or tread section, if serviceable.
Bruises and Jabs	Tire striking obstructions causes broken fabric which is not at first noticeable but which later develops into a blow-out by pinching the tube.	Sectional repair.

Chain Abuse	Anti-skid devices cause loose treads and broken fabric. Chains used on hard roads act the same as hitting obstruction.	Retread if fabric is not separated.

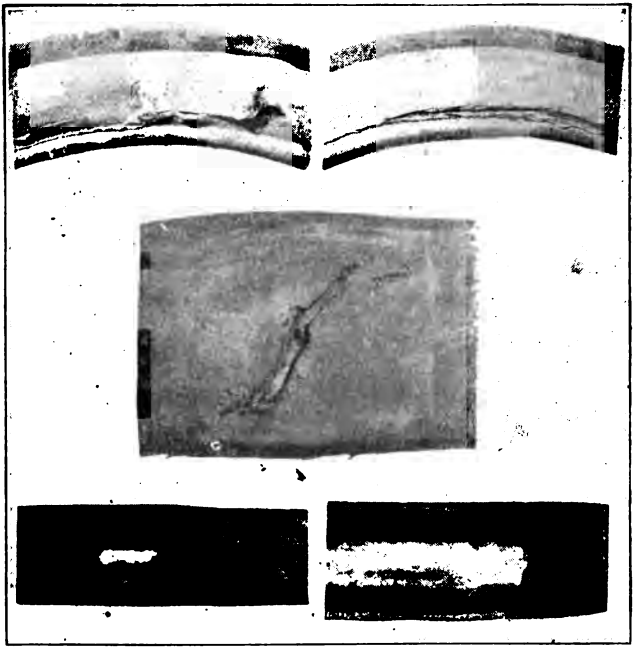


Figure 16.—Tire injuries and abuse. Top, run flat, rim cut. Center, blow-out. Bottom, brake abuse, under-inflation.

Curb Abuse	Running against the curb causes worn side walls and bruises from projecting obstructions.	Replace side wall or section repair.

Defective Rims	Bent channels on rims cause rim cuts.	Side section if small rim cut.
Deterioration	Carrying or exposing tires to heat, light, or bad weather, when not in use, hardens or gum-checks the rubber and sets the carcass. Being carried in stock a long time crystallizes the tire.	Retread may be practical.
Fender and Bolt Cuts	Overloading the car causes the fender or projecting bolt to cut into the tire.	Retread if fabric is good.
Fillers	Reliners, blow-out patches, etc., heat and chafe the fabric, causing fabric breaks from the internal friction. Eliminates guarantees and shortens mileage.	Remove and repair as required when found.
Glass Cuts	Allows water, dirt, etc., to work under the tread and plies of fabric, causing loose tread, sand blisters, separated fabric, and blowouts.	Tread patch, retread, or section.
Leaky Tube	Air coming from a leaky tube, even in a new case, causes separated fabric and side wall glows.	Replace the side wall.
Misapplication	Applying S.S. tire on Q.D. rim causes rim cuts; Q.D. tires on S.S. rim causes stretching of bead and blowing from rim. Be sure universal rims are applied correctly.	Usually beyond repair.

Moisture and Dirt	Any abuse that opens the tread or side wall, allowing dirt or moisture to work under the tread or between the plies, is not adjustable. Allowing tire to stand in water will, in time, cause tread or fabric separation.	
Nail Holes	Cause loose tread, separated fabric, and sand blisters from water and dirt working in, resulting in blow-outs.	Tread patch or section, as required.

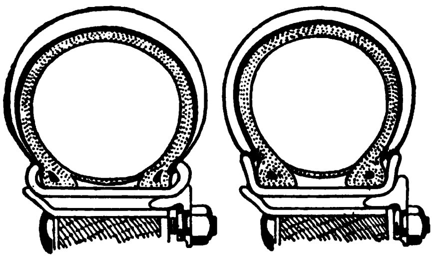


Figure 17.—Mis-application. Left, straight side tire on clincher rim. Right, clincher tire on straight side rim.

Neglected Cuts	Water and dirt cause loose treads, sand blisters, and blow-outs if not repaired.	Tread patch or section, as required.
Oil and Grease	Takes the life out of rubber. Collected from oily roads, greasy garages, or from grease in axle working out and spattering on side walls. Softens and causes loose tread and side walls.	Wash off or retread and replace side wall.

Overloading	Causes loose treads or broken side walls, allowing casing to give way; also rim cuts and inside breaks around the tire. A flat appearance is noticeable.	Tire may give some mileage by relining or rebuilding.
Running in Car Tracks	Causes loose treads, separated fabric, and creases or breaks on the inside of the tire; also worn tread, due to the steel splinters found on the inside of the rails.	Retread if serviceable.
Run Flat	Causes loose treads, broken side walls, rim cuts, and separated fabric. This is the most expensive of all abuse and a flat appearance is noticeable.	Reline or rebuild if serviceable.
Rut Wear	Running in ruts wears and grinds away the side walls and cuts through the fabric.	Replace side wall if serviceable.
Sand Blisters	Same as *Neglected Cuts.*	
Snagging	Running on rutty, extremely rough, or frozen ground or on icy roads causes chipping and breaking of tread.	Retread or miscellaneous tread repairs.
Spinning Wheels	Fast starting or spinning the wheels in ruts or chuck holes causes worn and loose treads.	Retread.
Turning Corners	Turning at high speed causes rim cuts and tires to blow off of rim.	Side section if small rim cut.

Underinflation	Causes loose tread and rim cuts, loose fabric, broken side walls, and broken fabric on inside of case, with a flat appearance of the tire noticeable.	Retread, rebuild section, or reliner, as required.

Many of the foregoing injuries or abuses can be rebuilt, and repairs should be made to cover the conditions found; however, only such repairs should be made as are consistent with the mileage that will be secured from the tire when it has been completed.

RESULTS OF MISTREATMENT, SHOWING INJURIES OR ABUSES RESPONSIBLE

Recapitulation from Injuries and Abuses to Indicate Required Repair.

RESULTS	INJURY OR ABUSE	REPAIRS POSSIBLE
Blown or Loose Side Wall	Leaky tube or deterioration from oil and grease.	Section or replace side walls.
Blow-Outs	Bad repairs, bruises, glass cuts, jabs, nail holes, neglected cuts.	Sectional repairs.
Broken Fabric	Bruises, chain abuse, curb abuse, jabs, fillers, overloading, run flat, underinflation.	Section, reliner, or rebuild.
Broken Side Wall	Overloading, run flat, running in car tracks, underinflation.	Reliner or rebuild.
Deterioration	Oil and grease, gum checking.	Retread if serviceable.

Loose or Separated Fabric	Bad repairs, brake abuse, glass cuts, leaky tubes, moisture or dirt, nail holes, car tracks, run flat, underinflation.	Replace section, retread, tread and work reliner, or rebuild.
Loose Treads	Bad repairs, blocking, brake abuse, chain abuse, fillers, glass cuts, nail holes, neglected cuts, oil and grease, overloading, car tracks, run flat, spinning wheels, underinflation.	Retread or tread work.
Rim Cuts	Defective rims, misapplication, overloading, run flat, turning corners fast.	Side section if only short break.
Sand Blisters	Glass cuts, nail holes, neglected cuts.	Tread patch.
Stretching of Bead	Misapplication, turning corners too fast.	Side section if small.
Torn or Cut Treads	Fender cuts, bolt cuts, brake abuse, glass, rut wear, or spinning wheels.	Retread, tread section, or tread patches.
Worn Side Wall	Curb abuse or rut wear.	Replace side wall.
Worn Spots in Tread	Alignment, brakes skidding.	Tread section.
Worn Treads	Alignment, blocking, brake abuse, chains, car tracks, spinning wheels.	Retread if fabric is serviceable.

KINDS OF PNEUMATIC REPAIRS

The following list of pneumatic tire repairs and their uses is arranged in the order of the amount of work and material required.

The study by the repairman of the various repairs

and what they are used for will be essential before proceeding to specific work.

Knowing the cause of a defect or injury should enable the repairman to immediately determine whether a tire can be repaired, and if so, what kind of repair or combination of repairs should be made. The repairman must remember that his occupation is repairing tires, and in order to secure the good will of the customer he must use judgment in accepting a tire for repair, both for good work and also in regard to the amount of work to be done and on which an estimate is given the owner. Increasing the amount of work on a tire should never be done unless the owner is advised that further expense is necessary to put it into service.

Tires beyond repair should not be accepted for work merely to take the owner's money. Make the inspection on the merit or condition of the tire with the object of delivering mileage equivalent to the same or a less amount expended in new tires. If, in your judgment, a tire is defective, adjust or send it in to the branch or factory, as the defect may be the downfall of a repair providing injuries, which are not apparent, put the tire out of service. By following this course the owner will soon learn to depend on your judgment in all his tire matters, and it is then that the trade is of most value.

The expert repairman can almost make tires in the average shop should the occasion arise. The writer has superintended large shops in which aeroplane, regular sizes, and seven inch heavy duty tires have been built up from a ply remaining on the sectional mandrel and moulds. This was done to

provide tires in an emergency and mileage equal to new tires has been assured. This extreme work should only be done to put required sizes into service and not for sale. The cost of material runs high on such work and would run the mileage cost over that of a new tire.

Rebuilding, however, is practical when properly done in an amount sufficient to give good mileage at low average cost per mile. The repairman must be a first-class workman on all other repairs before starting this work. The point is brought to the attention of the workman at this time to prepare him for a field of repairing that is rapidly being developed throughout the country, and which will save millions of wasted miles remaining in tires which heretofore have been thrown away.

When putting a tire into service, several of the listed repairs may be used in one tire, or may be combined as a unit repair on which a certain value or cost is made for the amount of work. For example: a complete section might have a tread section and always takes a large reinforcement. Tread patches and tread sections are always reinforced from the inside of the tire; in fact, a reinforcement should be made on every fabric tire and on some cord repairs when outside work is done.

LIST OF ALL REPAIRS TO PNEUMATIC TIRES

(Arranged in Order of Extent of Work)

It should be noted that some repairs are similar for all kinds of tires.

KIND OF REPAIR	FABRIC TIRE	CORD FABRIC TIRE	CABLE CORD TIRE
Rebuild	Used	Possible	Not used
Recovering	Used	Used	Used
Retreading	Used	Used	Used
Recapping	Used	Used	Used
Section, complete (standard)	Used	Used	.....
Section, inner and outer cord	.....	.....	Used
Section, outer cord.......	.....	.....	Used
Section, inner cord.......	.....	.....	Used
Section, three-quarters ...	Used	Used	.....
Section, side	Used	Used	.....
Section inside	Used	Used	.....
Rebuilt side	Used	.....	.....
Recovered bead	Used	Used	Used
Rerun side wall..........	Used	Used	Used
Bead section	Used	Used	Used
Tread section	Used	Used	Used
Tread patch	Used	Used	Used
Side wall patch..........	Used	Used	Used
Reinforcement	Used	Used	.....
Lining patch	.....	.....	Used
Puncture patch	Used	Used	Used
Replace staples	.....	.....	Used
Reliner	Used	Used	.....
Cord separation	.....	.....	Used

MISCELLANEOUS REPAIRS SOMETIMES USED

	FABRIC	CORD FABRIC	CABLE CORD
Ply off with boot reinforcement	Used	Used	.....
Fabric layback section (outside)	Used	.....	.....

KIND OF REPAIR	FABRIC TIRE	CORD FABRIC TIRE	CABLE CORD TIRE
Tread patch and boot reinforcement	Used	Used	.....
Bias cut with boot reinforcement	Used	.....	.....
Ply wrap and boot reinforcement	Used	Used	.....

DEFECTS AND ADJUSTMENTS

The repairman should make his inspection and arrive at a conclusion as to the cause of an abuse or defect in such a manner that the tire owner is satisfied that he knows his business. Criticism of the tire owner's explanation as to mileage and cause should be avoided, as a broad knowledge of the tire business makes it possible to decide as to a possibility of adjustment and to convince the owner as to the trouble.

When sent to the factory branch for adjustment, tires are handled by a factory branch adjuster whose decision is final as far as replaced mileage is concerned. The owner and repairman handling adjustments on a tire sold must, for protection, be able to judge the tire as would the branch adjuster, especially when the adjustment allowed on other tires is less or is refused, due to an oversight on the part of the repairman.

Tires with the serial number buffed off, the name buffed off, or the mark "second" or "unguaranteed" branded on the tire, never carry a guarantee unless made by the seller on his own responsibility. It must be known and remembered that when such tires

are encountered, the factory will allow for no replacement.

All inspections of tires for injury, abuse, or defect should be made in a manner that will bring all parts of the tire under inspection. Examination should be complete in all cases. Even when one fault has been found, or shown to you, continue the inspection of the balance of the tire and be satisfied that no other injury exists. Use a suitable bench with such lighting facilities as will show the surface well.

First: Examine all around the tire for cuts, loose tread, wear, etc. Press heavily down on the tread, when loose spots will bulge outward from the carcass.

Second: Examine both sides for blown side wall, wear, and indications of broken side wall from running flat.

Third: Examine both sides at bead for rim cuts or broken bead.

Fourth: Press downward to examine inside of tire for nail holes, breaks, loose fabric, or indications of running flat or underinflation.

Fifth: On cord fabric tires; in many cases loose fabric develops in the carcass of the tire, and it is sometimes necessary to probe when determining the extent of trouble.

Sixth: Decide if repairable, adjustable, or junk.

Many things are taken into consideration in making adjustments: The length of time used or in service, the appearance of the tread, the date of manufacture, the territory and the weather conditions under which the tire is run. On territory adjustments, five conditions come up, namely:

City mileage on paved streets and smooth driving.

City and country mileage; usually on smooth streets and highways.

Country mileage on highways and level country.

Country mileage on rolling country and rough roads.

Country mileage in hilly and mountainous territory, including rocks and flint.

Weather conditions are considered with all of the above.

The length of time a tire has been in service is calculated as the number of miles per day actually run. For example, a 5,000 mile adjustment basis might be averaged at twenty-five miles per day for the number of days, and the tire should deliver its mileage in six or seven months. This would be contingent on the country and weather conditions under which the tire is used, as it cannot be expected that a tire will run as many miles on rough, stony roads or in wet, hot weather as it would on city streets in good weather. These conditions are not controlled by the tire manufacturer, and for this reason the first condition is not likely to secure as favorable an adjustment as the latter, even though the tire has not run the guarantee. Under any condition a merit adjustment must either show that the workmanship was at fault or the material is defective, and that the tire is out of service. If mileage is still in a tire and the tire serviceable, usually no adjustment is made.

Adjustments made outside those of merit or guarantee must be policy replacements. These may be

made for the reason that only a few adjustments have been received from a certain territory and from large dealers. They may also be made where there is both a defect or injury and a doubt as to what put the tire out of service, and when the injury is not such as to constitute abuse of the tire. These are matters of courtesy only.

Adjustments are for replacement of the tire at a cost less than the unrun mileage. However, the guarantee states that the tire may be repaired at the option of the manufacturer, which is covered under the head of "*Repair Adjustments*," to allow the tire to complete its unrun mileage basis and fulfill the guarantee. In cases where noticeable abuse has put the tire out of service, the tire will be repaired at a nominal cost and charged to the tire owner. This class of repairs should all be handled by the repairman.

LIST OF DEFECTS

The following is a list of adjustments possible when the injury was not caused by abuse, knowingly, or unknowingly.

DEFECT	CAUSED BY	REMARKS OR ADJUSTMENT.
Bead Separation	Due to bead pulling apart from loosened fabric, or by fabric splices crossing bead splice.	Adjustment.
Blown Off Rim	Due to cable breaking in cable bead tires of S.S. type.	Adjustment.
Blown at Splice	Due to several splices at one place, or crossing each other, causing hinge.	Possible adjustment.

Broken Above Bead	Through bead cover by poor bead construction.	Possible adjustment, although this defect has recently been overcome.
Broken Cable	Due to poor cable wire or connection.	Adjustment.

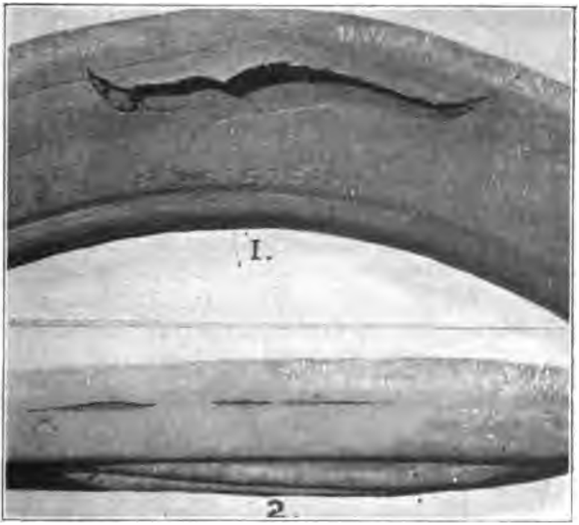


Figure 18.—Tire defects. 1—loose tread. 2—buckle or mould pinch.

Broken Fabric	If splice is blown or starts to break.	Adjustment.
Buckled Fabric	The fabric buckling up in the carcass of the tire because of the use of too much fabric, by a mould too small, or by not prop-	Adjustment.

	erly stretching the fabric on the carcass. Caused by building bead too low and wrapping on wrapped tread tires.	
Feathering of Tread Edges	Due to improper buffing and roughing.	Adjustment.
Improper Cure	Not found in tires now. Undercures have soft tread, overcures brittle or hard tread.	Adjustment.
Loose Bead Cover	Due to improper adhesion.	Adjustment.
Loose Tread	Due to improper buffing or roughing, or to poor application of cement, especially when cushion does not adhere to tread but stays on tire.	Possible adjustment.
Mould Pinch	Due to over-supply of material or mould too small, to buckles in center of tire, or building bead too low.	Adjustment.
Separated Fabric	Due to non-adhesive frictioning or defective material and workmanship.	Possible adjustment.
Separated Splice	Should be cemented and put into service.	No adjustment.
Worn Treads	Due to thin rubber or tread, not delivering mileage. Most trouble, however, is in alignment, as treads are tested for proper thickness.	Possible.

Under present inspections of the fabric before being accepted by the factory, defective fabric is not

admitted. The mills are under contract to deliver first-class fabric, and defective material is culled.

There are honest tire owners who deliver tires for adjustment and whose word can be taken as correct for the mileage run and the time in service. For the interest of these owners, every care should be used in examining the tire in order that proper information can be supplied the branch adjuster.

Many unscrupulous owners will make statements which, in the mind of the repairman, are incorrect, and he should handle these so as not to antagonize them. The correct information in the tire seller's or repairman's mind, should be sent in with the tire, as all tires adjusted by a factory branch are again adjusted at the factory for accuracy of the branch adjuster's replacement. Many factories instruct their branches that no profits are to be allowed or made on adjustments, and at the same time they are charged back with mistakes on all other replacements.

All car owners should be educated to know injuries and what causes them, and not to expect adjustments for reasons due to carelessness. The sooner this is done by the repairman, the more the customer will think of him. Perhaps the user does not know the cause and would be glad to overcome it; while if he does know, he is taking advantage of you and testing your experience to see how much you really know. If you know he is wrong and do not say so, his opinion is that you do not know much.

Between the two classes of men it is unnecessary to dispute their statements after you have given your opinion. It is then a question of merit adjustment, policy adjustment, reasonable repair, or rejection.

CHAPTER IV

REPAIR MATERIALS AND ACCESSORIES

The repairman works on the manufactured tire and has only to select a material prepared for his use. This material usually shows the use for which it is intended, and the specific gravity of repair gums is always available, especially on good stocks. The materials selected should always be of the best quality, of good friction or tackiness, and resilient and strong when cured. The working materials can be classified as gums, fabrics, cements, and miscellaneous.

Gums—Many kinds of gums are available in the repair trade. They vary according to the amounts of compounds used to obtain wearing or other qualities in the rubber. Gums of low specific gravity have a smaller amount of compound. In this class we have cushion gums, tube gums, and cement stock. As the specific gravity increases, more compound is used to withstand wear and friction. This will be found in tread and side wall gums. Too much or an inferior compound will lessen the resiliency of the rubber after cure.

Cushion gums are of a lower specific gravity than tread gums, being compounded to obtain resilient, adhesive, and quick-flowing qualities. This gum is used as a binder between the tread and breaker and

throughout the carcass of the tire. It has very little wearing quality when in contact with the outer surface. When used as a cushion, it absorbs and assists in distributing the shocks or bruises to the tire through the medium of the breaker strip. When used in repairing, it acts as a flux or binder in filling up breaks in the fabric of the tire. It is used as a binder at all tread splices and between all applications of new tread gum to the old tread. The average thickness used when repairing is 1/32 inch on fabric and cord fabric tires, while 1/64 inch is used extensively on cable cord repairs. These thicknesses will do for any and all practical work. Cushion gum is also used for gum stripping the edges of fabric splices, and should always be used between tread splices and to completely cover tread patches in one layer.

Tube gums are of a slightly higher gravity than cushion, as there is considerable expansion, friction, and heat to withstand. More sulphur is used, and they are of a shorter cure variety, usually ranging from five to twenty minute cure. Two kinds of tube gums are used, one for inside backing and the other for filler gum. The inside backing, or combination gum as it is called, consists of a layer of uncured gum, coated to a thin layer of semi-cured gum, the thickness being about 1/32 inch. This combination gum is used on the inside of the tube to back up the hole or injury and with its uncured side against the tube and the semi-cured side facing the interior of the tube to prevent sticking when a cure is made. The filler or raw tube gum can be ordered in any thickness, usually in grey or black. A thickness of 1/32 inch is, however, the most practical, as it can be built

up to any required thickness when cut in strips for filling. At the same time it can be used in single thickness for sealing strips around the edges of the injury to cover the new and old stock.

Tread gums and side wall gums are practically alike in regard to the heavy amount of compounds used to withstand road wear and friction. In repairing tires, these gums should not be used for any other purposes than these specified, although tread gums may be used for other rubber work.

The color of the gum is optional with the tire manufacturer and is determined by the compounds or chemicals used. For this reason the exacting repairman will order his gums from manufacturers to match all colors of gums on various kinds of tires. There is usually some change in the color of gums after cure, and in order to secure the proper final colors for uniform appearance, samples of the various gums should be cured on the tube plate and used to arrive at the exact tint. This will be of assistance to new men or students.

Tread and side wall gums come in any thickness, 1/16 inch being used for almost all kinds of work; 3/64 inch is used on shell type airplane tires, while 3/32 inch is used to some extent on retreading.

Fabrics—Fabrics are classified in the tire trade on their thickness and the frictioning or coating of the surface. Fabrics of the various kinds are used for a specific purpose in the construction of the tire or for repairs.

Some manufacturers may friction only one side for a certain purpose, while others may friction and skim-coat for the same use. The following is a list of

possible frictioning (F) and coating (C) for all kinds of tire fabrics:

Building fabric, F 2 sides C 2 sides, weight from 12 to 17½ oz. sq. yd.

Building fabric, F 2 sides C 1 side, weight from 12 to 17½ oz. sq. yd.

Building fabric, F 2 sides C 2 sides, weight from 12 to 17½ oz. sq. yd.

Bead cover fabric, F 2 sides in light weight, 8 oz. sq. yd.

Bead cover fabric, F 2 sides C 1 side in light weight, 8 oz. sq. yd.

Bead cover fabric, F 2 sides C 1 side in heavy weight, 12 oz. sq. yd.

Bareback fabric, F 1 side C 1 side only, weight 15 to 17 oz. sq. yd.

Bareback fabric, F 1 side only, weight 15 to 17 oz. sq. yd.

Breaker fabric, F 2 sides in block weave.

Breaker fabric, F 2 sides in C 2 sides, coarse weave.

Cord fabric, F 2 sides in C 1 side, light weight.

Cord fabric, F 2 sides in C 2 sides, heavy weight.

Cords, cable, Frictioned and coated outside only.

Cords, cable, Impregnated, frictioned and coated.

For regular use, building fabric F 2 sides C 1 side is sufficient for all repairs and should be specified when ordered for shop use.

The term, "frictioned and coated," means that friction stock of an adhesive nature is forced into the fabric by calender rolls at the factory which apply the first coat or friction into the meshes of the fabric. Afterward, a skim-coat is applied by the same rolls in order to give more of a binder or flux between the

materials when placed on the tire. The coating usually runs about 1/64 inch thick.

All building fabrics, barebacks, bead cover, and breakers are classed as square woven fabric. Cord fabrics are first made from twisted cords and are then bound together by cross threads, after which they are frictioned and coated similar to common fabric.

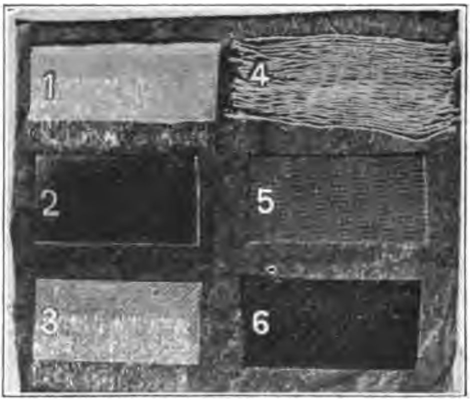


Figure 19.—Fabrics. 1—square woven fabric, plain. 2—fabric, F2, C1. 3—bareback, F1 only. 4—cord fabric, plain. 5—heavy cord fabric, F2, C2. 6—light cord fabric, F2, C2.

Cable cords are composed of several twisted cords in which the individual cord is entirely covered or impregnated with the friction stock. In cable cord tires or repairs, the cords are built individually, while cord fabric is applied in a way similar to fabric.

Care of Materials—Repair fabrics and gums must be kept away from dust, soapstone, oil, sunlight, and out of drafts. Select a medium dry place not ex-

posed to the light to any great extent, so that the stocks will always be fresh and tacky for use. As soon as the materials are received, hang them up on rolls and provide dust covers over them. Never lay rolls of repair stocks flat on the floor, nor stand them on end. When using the gums and they stick to the holland, wet the opposite side slightly with benzine or gasoline and the material will loosen.

Cutting of Materials—Fabrics are cut on the bias, or a 45 degree angle, to allow for expansion and strain on the material as in the new tire. This also allows for proper shaping to the contour of the tire when building, and increases the life and resiliency in the repair. Building fabric, when cut straight, will bulge and cause hard repairs. The breaker is usually cut straight when repairing a tire, although many manufacturers cut it on the bias in the original tire. Bead covers should always be cut on the bias. Gums should be cut with the grain as much as possible, as the calendar produces a grain in the rubber. All selvage should be cut away from bareback fabrics and other materials, as it will cause a bind in the repair if used.

In connecting fabric for use, a lap of one inch is made by uniting the fabric, which in all cases must be done on the bias. Never connect fabrics by cutting straight, as such a method will place a direct bind in the repair.

In connecting bareback, one side of the material is plain and therefore no connection can be made unless time is taken to cement it. The practical connection is to butt where it is cut on the bias and to apply a strip of cushion gum one inch wide to the frictioned

Figure 20.—Cutting fabric, showing fabric lap and butting bareback.

or coated sides. Application of bead cover would answer the same purpose if cut on the bias.

Should oil, grease, dirt, or bloom appear at any time on the gums or fabrics, they can be removed by washing slightly with high grade gasoline or benzine. The appearance of bloom on raw gums is not a sign of inferior material, as all gums will bloom if exposed to the air for a period of time. This is the appearance of free sulphur due to chemical action from the air and light, and is also due to chalk and zinc oxide compounds. Never allow stock to become damp or wet, as blown repairs will result.

All rubber trimmings, either in gums or fabric, should be carefully placed in boxes, covered from the dust, and saved. The scrap fabric can be used to make cement; while all gums, when sorted as to color and condition, can be returned to the factory for recalendering or for credit on new materials. Gums can be recalendered for about ten to 15 percent of the cost of new gum, the equivalent being allowed on credit. When returing gums to the factory for recalendering, a list of their kinds, quantities, and weights should be enclosed in the box and fully protected.

In all cases, aim to use up all scrap and small pieces of tread gums or cushion. It will be found that there is very little waste if this advice is followed. Use all old gums first, and do not get into the habit of using the new stock just because there is fresh material on hand. Such a habit causes a large waste of repair materials. A slight washing with high grade gasoline will put life into apparently dead material.

All fabrics are applied with the coated side down against the next ply of fabric or on the tire. In this way a frictioned and coated side is always in contact. A slight pulling tension is used when stitching the fabric in place, and as the material is applied toward the bead, the pull draws the fabric to fit the contour of the tire. Wrinkles should always be eliminated, and when bunched, the material should be loosened up and the wrinkle worked out toward the side of the tire.

Cement—Vulcanizing cements can be made by the repairman in his own shop, as can other cements used in a general line of repairs. Rubber, when cut by any solvent, appears for a time to retain its shape until stirred to a mass. This is due to the swelling or expanding of the rubber itself, while all the time it is losing weight.

When making cement or any kind, it should be stirred evenly and slowly, as it will then have better adhesive qualities than if beaten or churned fast. The writer is of the opinion that the repairman will secure better results by purchasing a good cement and sending the trimmings in for credit than he would by making cement. This is due to the fact that repair materials are not always made of the same compound as the factory cement. However, if only cushion gum of the best quality is used, and no tread gum of any kind is added, fairly good results can be obtained for regular work. Regular cement stocks can be ordered if desired. All cements should be stirred before using.

Solvents of rubber include high-grade gasoline, benzol, alcohol, ether, naphtha, toluene, carbon disul-

phide, chloroform, and hydrocarbons of coal oil and coal tar. There are other chemicals used as solvents of rubber, but for the practical repairman, high-grade gasoline or benzol is used in the shops. Many different theories are advanced as to what makes the best vulcanizing cement for shop use.

When cement is to be made in the shop, a good grade of gasoline should be used first to cut the gums to a thick solution. Then add about twenty-five per cent, or one quart to the gallon, of benzol or high test gasoline in order to secure drying qualities. One pound of good cement or cushion gum to one gallon of gasoline should be used and stirred gradually. Should the gum not cut smoothly, add one ounce of alcohol to hasten cutting. This will also have some tendency to temper the cement.

While good high-grade gasoline is recommended for mixing cement, benzol is likely to give the better results provided good gasoline cannot be secured. The benzol takes slightly less time to dry and leaves no oil. The present grade of so-called gasoline carries considerable oil. Gasoline can be tested by placing a small amount on a piece of white paper; if it evaporates leaving no trace on the paper, it is safe to use. Good gasoline with a low end boiling point will leave a white appearance on the hand when evaporated. Gasoline might have a high gravity of about seventy-five degrees and still contain oil which will cause trouble. Good results can be obtained from high-grade gasoline, as the use of benzol causes the cement to become hard in a short time, requiring a quick build-up. Benzol, like gasoline, should be kept away from an open fire, as it ignites very easily.

Keep the cement covered at all times while it is cutting. This will keep out the dust and dirt and also prevent evaporation of the gasoline.

Patching and acid-cure cements should be purchased from the manufacturer. These are used for all cold work, such as applying tube patches, valve pads, splices, repairs to raincoats, patches to boots, etc. With the acid-cure cement, the curing acid is used. This is merely a solution of carbon disulphide which can be purchased at any drug store and used.

COMPLETE LIST OF REPAIR MATERIALS

The following list is complete as to materials ordinarily used in repair work or for service in a large vulcanizing shop. It also gives the use and description of the article:

Acid (Carbon Disulphide).—Used with patching cement for application of patches. The acid is brushed quickly over the cement and the patch or splice applied at once.

Alcohol.—Mixed in quantities of one ounce to the gallon to assist in cutting rubber for vulcanizing cement.

Bands, Retread.—Come in any size for retreading work and can be purchased plain, ribbed, or in non-skid design, according to the manufacturer.

Boots, Lace-On.—Used in sizes to cover blow-outs or weak places in tire. Applied with laces.

Boots, Hook-On.—Used the same as lace-on boot, coming with clincher or hooks to fasten under the bead of the tire.

Brushes, Buffing.—Can be supplied in six, eight, or ten-inch size with any spindle hole.

Cap, Dust.—Used for applying over the entire valve to keep out water and dust.

Caps, Valve.—Applied to tube valve of any size.

Cement, Patching.—A chemical gum cement for cold application of patches to rubber.

Cement, Acid Cure.—Similar to patching cement, but of lighter quality. Set with acid.

Cement, Vulcanizing.—Used for all tire and tube repairs where vulcanization is made.

Cord.—Used for tying tags to tires and tubes. Essential in any shop.

Figure 21.—Repair accessories. 1—everlock. 2—lace-on boot. 3—cord patch. 4—acid. 5—khaki-back. 6—rubber patch. 7—tire plaster. 8—flap. 9—talc. 10—reliner. 11—retread band. 12—tape. 13—patches. 14—valve cores. 15, 16, 17—valve pads. 18 to 21—valves.

Cords, Cables.—Ordered in inner and outer sizes according to construction of tire for repairs on cable cord tires.

Must be purchased from same manufacturer as the tire to be repaired, or secured from old tires.

Cores, Valve.—Used in all tube valves for holding air in the tube.

Fabric, Bareback.—Used as a last ply on reinforcement to repair, for friction or coated one side.

Fabric, Building.—Used in all rebuilding on pneumatic tires, frictioned two sides, coated one.

Fabric Breaker.—Placed over the cushion, below the tread and around the tire.

Fabric Bead Cover.—Used in one or two plies for chafing strip on the bead of the tire.

Fabric, Cord.—For rebuilding cord fabric tires. Use same kind as make of tire.

Fabric, Everlock or Khakiback.—Used for general cold patching work on tubes, etc.

Flaps.—Ordered in size to fit the individual tire. Protects the tube against the rim and beads of the tire.

Filler Strips.—Use to fill bead channel of Q.D. rim when applying a S.S. tire, also in bead mould when curing tires in emergency.

Gasoline.—For general shop work, such as washing stocks and repairs, making cement, and for operation of gasoline burner outfits.

Glycerine.—Used for polishing or shining rubber, not wholly beneficial.

Gum, Combination Backing.—Used in tube repairs for backing the hole repair. Semi-cured one side.

Gum, Cushion.—For filling injuries, such as a cushion to the repair, and for application between tread splices. Thickness of 1/32 or 1/64-inch used.

Gum, Patching.—A cured thin rubber for general cold repairs.

Gum, Tread.—For all outer repairs to the tire; acts as sole to shoe; 1/16-inch mostly used. Colors are optional for the tire worked on.

Gum, Tube Filler.—Used in five to twenty minute cure varieties for tube repairs in filling the hole.

Mica or Talc.—Used for lubricant between tube and case, being dusted or sifted into the casing when the set-up is made.

Pads, Valve.—Or valve bases, for application in sizes to tubes when inserting valve.

Paper, Sand or Emery.—Used for cleaning moulds and plates and for general shop use.

Paint, Graphite.—For application to rims to prevent freezing of tire to rim. Graphite with paraffine, makes a good medium to prevent tire from sticking in mould.

Patches, Blow-Out.—Made of several plies of fabric; to place in tire over a small hole to protect the tube temporarily. Fillers of this kind are injurious.

Patches, Cementless.—Used for repairing small holes in tubes by dipping in gasoline and applying. Made in sizes.

Patches, Cement.—Same as cementless patches, but applied with patching cement. Made in sizes.

Patches, Cord.—A special blow-out patch made to be vulcanized in cord tires. Made in sizes.

Reliners.—Made in sizes or as ordered for reinforcements to the inside of a tire run flat or broken on the inside walls. A temporary repair unless properly cured.

Staples, Cord.—Used in repairing Silvertown cord tires. Sizes, No. 2 and No. 4.

Soapstone.—Used in general shop work to prevent sticking of tires to moulds, etc., also as filler for non-skid tire treads when curing.

Tags, Repair.—For identification on all repairs in the shop.

Tape, Tire.—For general shop use and sale to customers.

Valves.—Made in sizes for the tube.

Valve Parts.—Such as washer, bridge washer, valve nut, rim nut. All ordered in sizes to fit the valves in use.

CHAPTER V

TOOLS

As in every other trade, the workman must have good hand tools. This is more essential in this than in many other occupations, due to the fact that it requires skill to cut down tires and to build them up. No expert tire repairman will attempt to work with dull and greasy tools and they should never be found in the shop. All knives and implements should be sharp, and free from grease, oil, and soapstone, which are injurious. The following list of tools has been arranged in the order that a repairman works.

An outfit as complete as listed is not required in smaller shops, and for this reason the essential tools have been marked with an asterisk (*) in order to provide a list suitable for one man doing all the work. Shop equipment will be described in another part of this book. If possible, all tools should be placed in separate boxes for each kind of work, and not allowed to lie on the benches and floor, as much time may be lost in looking for them.

Items checked are the tools ordinarily used, being duplicated in different sections of the work.

GENERAL SHOP TOOLS

Outside of actually repairing tires, many cases require extra tools for handling the situation and keeping the plant and shop in order.

Bar, Claw.—Useful in opening boxes and general shop work that requires prying.

Blades, Hack Saw.—To replace those worn out.

Braces and Bits.—For general shop work.

Brushes, Counter (Hair).—For shop cleaning and dusting. Essential and used daily.

**Brushes, Buffing (Wire).*—Eight or ten inches long, for buffing tires and tubes.

**Cans, Gasoline.*—A number of one-gallon size for gasoline, oils, etc.

**Chisel, One-half Inch Cold.*—Required in many cases for splitting valve nuts and general work.

Files.—Twelve inch flat for general shop work.

Funnels.—Useful in pouring gasoline, etc.

Hammer, Claw.—General shop work.

Hammer, Machinist.—Two-pound, general shop work and changing work.

Level, Wood.—Used on line shafts and for general use.

**Pliers, Combination Six Inch.*—Every repair and service man makes use of this tool.

Saw, Hack.—For general shop work.

Saw, Hand.—For general shop use.

Tool, Dressing.—Used to keep emery stones straight and true.

**Vise, Bench.*—Used for all general shop work.

**Wheels, Eight Inch Carborundum.*—For shop grinding and grinding of tubes and cases.

Wrench, Fourteen Inch Stillson Pipe.—A useful tool for tightening piping and fittings on steam lines.

TUBE REPAIR TOOLS.

**Brush, Cement.*—Of ¼ inch width, used for applying patching or vulcanizing cement to tube holes and repairs. Separate brushes should be used to prevent mixing the cements.

Brush, Wire.—A flat brush used for roughing a tube repair when no buffer is available. Useful at all times on the tube bench.

Deflator, Tube.—Hand winding device for forcing air from tubes before tying up for delivery or the shelf.

File, Six Inch, Three Cornered.—Used for general work on the bench.

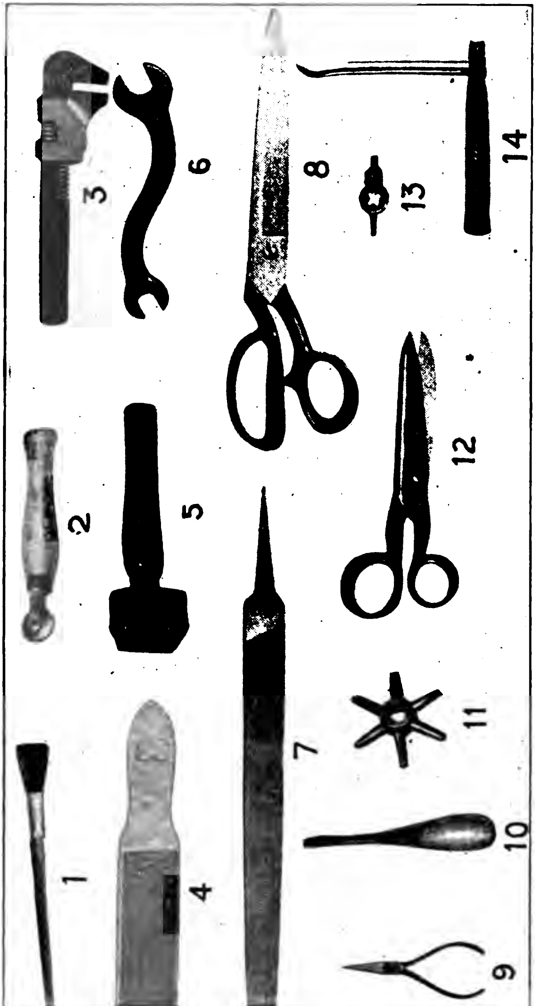


Figure 22.—Tube repair tools. 1—cement brush. 2—stitcher. 3—wrench. 4—wire brush. 5—roller. 6—S wrench. 7—flat file. 8—scissors. 9—pliers. 10—screw driver. 11—star wrench. 12—curved shears. 13—valve tools. 14—socket wrench.

******File, Twelve Inch Flat.*—Principal use is for removing valve cores by pointing the handle end.

**Pliers, Six Inch Combination.*—General bench use for removing nuts, bridge, washers, etc.

**Pliers, Plugging.*—Used for holding combination backing gum while inserting through the hole, and also for plugging filler gum against and into the cemented side of the injury.

**Roller, 2"x2" Flat.*—For rolling down repairs and splices and uniting gums, also as a building tool.

**Screw Driver, Four Inch.*—For lifting valve washer and for loosening splices and valve pads.

Scissors, Curved.—Useful in cutting circular holes around injury.

**Scissors, Straight.*—For cutting gums and holland. Also as a building tool.

**Stitcher, One Inch Corrugated.*—For stitching all repairs on the tube. Also as a building tool.

Valve Socket Wrench.—Made from brass pipe to fit down over the valve and heated while driven to fit the nut. A handle is then inserted, making the best tool for removing valve nuts.

**Valve Tool.*—A four part tool for removing valve core, reaming, tapping and smoothing valve.

Vise, Bench.—Useful for general bench work.

Vulcanizer, Gasoline.—For curing patches when the tube plate is cold.

Wrench, Bicycle.—For removing or starting valve nuts when rusty or frozen on.

**Wrench, "S."*—Used for same purpose as bicycle wrench.

**Wrench, Star Valve.*—Two sized valve nut removers, used extensively.

CUTTING DOWN TOOLS.

Awls, Locating.—Used by the beginner and forced through the tire from the inside and at both ends of the injury. This shows the exact length of the injury outside the tire. The section is then marked and started.

**Awls, Fabric.*—Usually of the ice pick type, for prying and loosening fabric and cords so they can be removed with the pinchers. Sometimes called scratch awl.

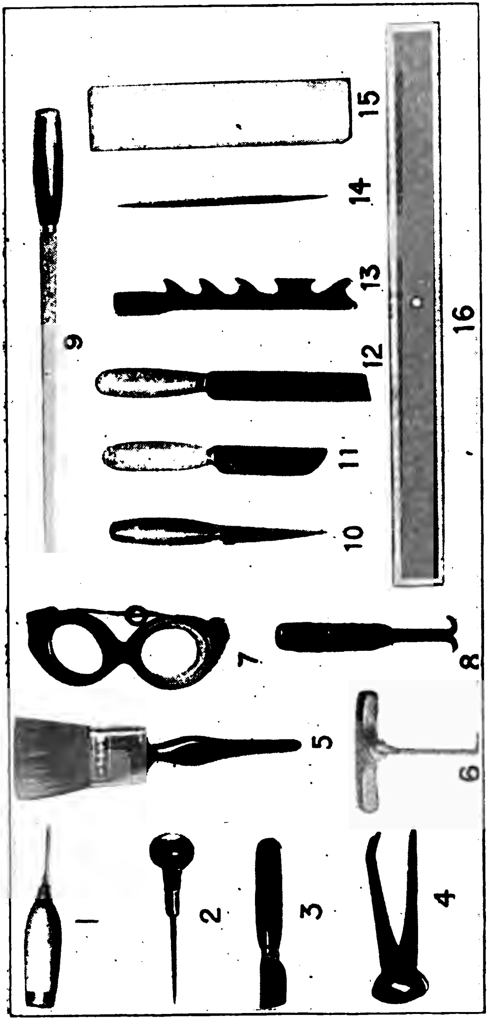


Figure 23.—Cutting down tools. 1—locating awl. 2—fabric awl. 3—notched knife. 4—pinchers. 5—brush. 6—tread gauge. 7—goggles. 8—fabric hook. 9—prodding tool. 10—skiving knife. 11—tread knife. 12—rubber knife. 13—spreader. 14—small file. 15—sand stone. 16—steel rule.

**Brush, Cement, Four Inch.*—For cementing all repair work at the bench.

Brush, Tack.—Made in the shop by driving tacks through a leather strip and applying to wood back. Its use is to rough-splice in the tread so that the cement will run in and take hold. Rasp is also used for this purpose.

Brush, Wire.—A narrow wire brush used for cleaning inside of case with gasoline, especially when the tire has a stiff bead and cannot be turned without bending or breaking the bead.

**Cans, Covered.*—Provided for holding water, gasoline, and cement for bench use.

**File, Three Cornered, Six Inch.*—Used for beading or notching the fabric knife.

**Goggles.*—For use when buffing, to keep rubber and dirt from the eyes.

**Gauge, Tread.*—For marking tread when it is to be removed for retread. Also a building tool.

Hooks, Pulling.—Either single or double gripping and pulling fabric after loosened or in strips.

**Hooks, Layback.*—Made in the shop of No. 10 iron wire and sharpened on both ends, after which it is V'd to catch the layback and to hook into the tire to keep them apart.

**Hooks, Drying.*—Placed at the top of shop for drying cemented tires.

**Hook, Work.*—Arranged from ceiling with heavy cord to support tires while doing inside scraping or cementing. Some shops use a special frame with set in rest plugs. Used also in building.

**Knife, Fabric.*—A 1½ inch knife with a bead or notch filed in the end for slitting fabric in steps and strips. Can be purchased or made from an old worn down rubber knife. Should not be notched too deep, as it will then cut the under ply.

**Knife, Skiving.*—A four inch knife tapered to a sharp point for trimming and rounding a hole or injury and for all skiving to a feather edge.

**Knife, Tread.*—Usually a four inch rounded knife for cutting the tread layback and along the sides of tread. An old rubber knife will make a tread knife.

**Knife, Rubber.*—A six inch knife for cutting away rubber and general trimming.

Mandrels, Wood.—A wooden form made in sizes to fit inside the tire and give body or shape while cutting down.

Mandrel Forms.—Made of wood and used for turning tires and for holding the tire for inside work after turning.

**Pinchers, Carpenter.*—Five inch length for pulling old rubber and fabric from the carcass after being loosened.

Prodding Tool.—A long, thin-bladed knife or probe for inserting under plies in tire to locate loose or separated fabric.

Rasp, Wood.—Twelve inch length for roughing all repair work, especially on tread cuts and splices.

**Rule.*—Steel or wood for measuring repairs and marking work.

Scraper, Tire.—A three-cornered tool for scraping inside of tire when not possible to be turned.

Screw Driver, Four Inch.—For same use as fabric awl, to loosen fabric and for general prying of a heavy nature.

**Spreader or Jack.*—Wood blocks for spreading the tire for inside work and cementing. Also made in metal with notches for the same purpose. Called tire jacks or stretchers. Flat, one inch wide and about eight inches long.

**Sand Stone 2"x2"x8".*—Used for sharpening flat knives. Carborundum sticks or stones can be used.

BUILDING UP TOOLS

**Awl, Perforating.*—Sometimes called punching awl. A short, thin-bladed awl for perforating gums to release air and for perforating air vents in the whole repair before curing.

Cans.—For holding water in which to dip knives while cutting; also for gasoline for washing.

**Gauge, Tread.*—Used for marking the side wall on both sides for application of retread. The bead is used for a guide.

**Hook, Work.*—Made of one-quarter inch iron. Hangs from ceiling on adjustable cord. Used for holding tires during inside work. Some shops use a slide rack placed against a wall or rack.

**Knife, Trimming.*—A six inch knife, same as cutting knife, for trimming off surplus gum and edges.

Knife, Stubbing.—Made from a broken knife about three-

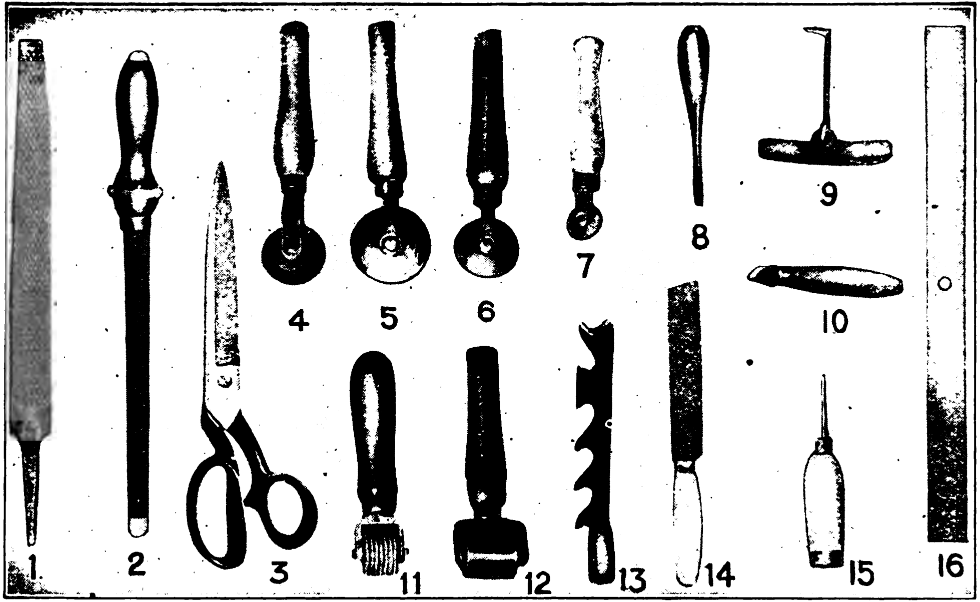


Figure 24.—Building-up tools. 1—rasp. 2—sharpening stick. 3—shears. 4 to 7—stitchers. 8—prodding tool. 9—tread gauge. 10—stubbing knife. 11, 12—rollers. 13—tire spreader. 14—trimming knife. 15—tire spreader. 16—steel rule.

quarters of an inch long and rounded. Used for inside cutting by pressing lightly on the fabric just below bead toe.

Mallet, Rubber.—A large rubber hammer used in some shops for tapping and pounding repairs for uniting.

Rasp, Wood.—A course twelve inch rasp used in many shops for trimming and shaping repairs on tread. Good smoothing can be done with this tool.

**Roller, 2"x2" Flat.*—A round steel block with handle for rolling gums. The uniting of flat gums is best done with this tool.

Roller, Cord.—A small round steel roller, with ribbed corrugations to fit cable cord tires. Made in three sizes.

Roller, Concave.—Of 2x2 inch size, used for outside repairs and retreads. The curve of the roller fits the contour of the outside of the tire.

Roller Convex.—Of 2x2 inch size used for inside rolling of reliner and patches. The curve of the roller meets the inside contour of the tire.

Roller, Porcupine.—A small roller with sharp steel points about three-eighths of an inch long, used for same purpose as perforating awl, in perforating repairs and gums.

**Rule, Steel or Wood.*—Used for measuring gums, fabrics, etc., when building.

Screw Driver.—A small four inch bulldog type for prodding or loosening gums before trimming.

**Scissors, Twelve Inch.*—Used for cutting gums and fabrics.

**Spreaders.*—Sometimes called tire jacks or spreaders. Can be made of wood blocks of various lengths, and used for spreading the tire while working on the inside.

**Stone, Sand.*—Or carborundum stick, for sharpening knives.

**Stitcher, One Inch Corrugated.*—For narrow rolling or uniting of gums or fabric in a repair. Also made smooth and in other sizes.

**Straight Edge.*—A wood rule, preferably five feet long, for marking fabric when cut on the bias across the roll.

STEAM AND CURING TOOLS

Brush, Cement.—Used for applying patching cement to pad and tire when the pad is set by this method.

**Brush, Wire.*—Large wire brush for cleaning and removing soapstone from tire.

**Clamp.*—Used for locking bead moulds together on clincher and Q. D. tires before placing in the mould. S. S. tires are set in first and the bead mould then placed.

Clock.—For time.

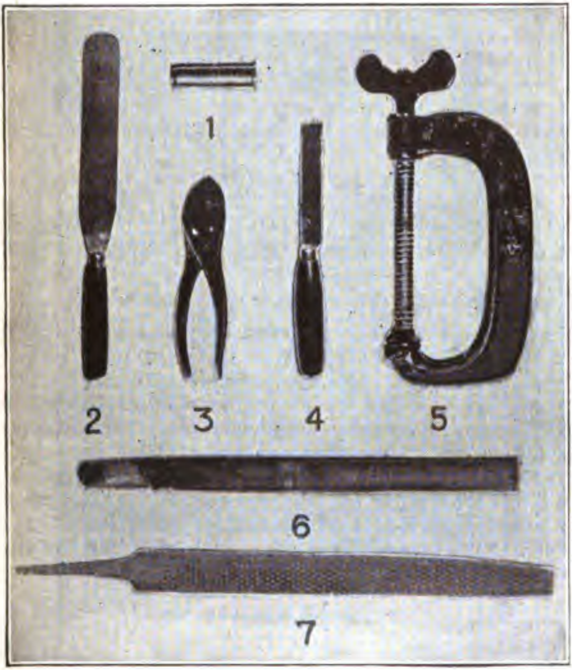


Figure 25.—Curing tools. 1—air gauge. 2—soapstone knife. 3—pliers. 4—trimming knife. 5—C clamp. 6—prodding tool. 7—wood rasp.

Gloves, Leather.—Used in pairs for handling hot bead moulds and for general steam work.

Gauge, Air.—Used for testing air bags when inflated, and frequently to show leaky bags.

Knife, Rubber.—A six inch knife for trimming cured work.

**Knife, Soapstone.*—A flat, long-bladed knife with dull edge for applying wet soapstone to non-skid designs.

**Mallet, Rubber.*—Large hammer for tapping tight bead moulds into place.

**Plier, Combination.*—For general use, turning pet-cocks, etc.

Prodding Tool.—Used like a screw driver, mostly to loosen bead moulds.

**Rasp, Wood.*—For smoothing and rasping repair work and for taking off bumps or ridges.

Ruler, Steel or Wood.—For measuring length of completed repairs.

**Screwdriver, Six Inch.*—Used for removing bead moulds and for general work.

Thermometer.—Used for indicating temperature of moulds, etc. Better to use thermometer connected to steam line.

CHANGING TOOLS AND SERVICE ACCESSORIES

Service or changing tools are the most neglected items in a shop, while they should be the most important. The success of a repairman's business depends on the class of service that is given under the eyes of the owner when changing and placing tires on the car. For this reason, a complete set of changing tools should be arranged in a portable tool box with handle. The box should also contain such accessories as required to put the tires on a car into running condition when at a distance from the shop. When at the shop, all tools should be ready for instant use and not lying all around.

CHANGING TOOLS IN BOX

These tools are all used

Chisel, Cold.—Used for general work in changing.

Gauge, Air.—For testing inflation.

Hammer, Machinist.—Of two and one-half pound weight for tapping rim from car and for applying tires. Should be of good weight to prevent recoil.

Jack.—For raising car and for forcing split rims into place with use of wood blocks.

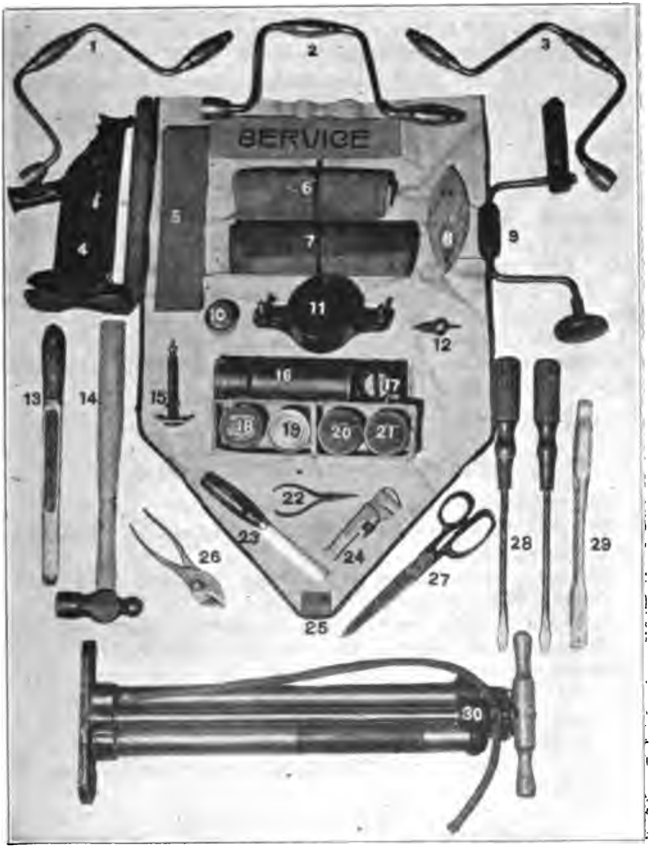


Figure 26.—Service and tire changing tools. 1, 2, 3—single rim wrenches. 4—jack. 5—khaki-back patch. 6—lace-on boot. 7—blow-out patch. 8—valve pad. 9—utility wrench. 10—flap. 11—gasoline vulcanizer. 12—valve tool. 13—perfect tire tool. 14—hammer. 15—valve. 16—mica. 17—tire tape. 18—tire putty. 19—cement. 20—patch. 21—tube gum. 22—plugging pliers. 23—trimming knife. 24—wrench. 25—valve cores. 26—pliers. 27—shears. 28—screw driver. 29—changing tool. 30—pump.

Pliers, Combination.—For loosening rim nuts and for general work on lock rings.

Pump, Air.—A hand pump, usually two or three cylinder. Should be kept in good condition at all times.

Screw Drivers.—Two ten inch screw drivers are best for applying tires of all types.

Tank, Air.—Used in place of an air pump on good service cars. Usually carries 200 pounds pressure and has hose attached.

Tire Tools.—Special tire tools can be secured for hand use. One with a curved lip should be used for good service.

Valve Tool.—For reaming valves and retapping. Also for inserting cores.

Wrench, Flat.—Useful for general work.

Wrenches, Rim.—Used in sets or in a single adjustable type to fit all sizes of wedge nuts.

SERVICE ACCESSORIES IN KIT

(For road service away from shop)

Boots.—Lace or hook-on, in sizes as used.

Brush, Cement.—A small brush for applying vulcanizing or patching cement.

Cement.—Patching or vulcanizing, in small cans.

Knife.—For trimming.

Pad, Valve.—For replacement in extreme cases.

Patches, Cold.—Either for use with patching cement or gasoline patches for quick repair of punctures. Khaki back patches can be carried in sheets and cut to size.

Plugging Pliers.—For general patching work if vulcanizing is done.

Scissors.—Small pair for cutting and trimming hole and material.

Talc.—For lubrication of tire before inserting tube.

Tire Dough or Mastic.—For applying in small cuts. Not essential.

Valve.—Two should be carried for emergency.

Vulcanizer, Gasoline.—Should be carried with small amount of gasoline when curing is done. Also carry some backing and filler gum.

In this connection, where a regular service car is used, it is advisable to carry an extra tube and new or old cases, as the size of the tire can be learned when a call comes for service.

CHAPTER VI

FABRIC TIRE REPAIRS

CUTTING DOWN AND BUILDING FABRIC TIRES

When the repairman has become acquainted with general information relating to tires he is better able to begin the various operations and repairs which are used for remedying the different injuries. The following detailed steps for each operation are given in the order found while cutting down or building up a repair. They are also arranged in proper order either for a shop of only one bench, or for progressive arrangement as the work goes through the shop.

Almost every known system of repair is shown in order to enable the workman to follow the system used by the shop that he may be working in. Some methods of repair are not used by good shops; however, the workman must be able to conform to the methods of his employer until such time as he is able to demonstrate the recommended repairs that are selected for long service. Repairs shown as standard, when properly made, can be depended on to deliver satisfactory mileage and long service.

The first operation in repairing tires is that of cutting or tearing down, which makes the tire ready for buffing, cementing and then building before going to the steam room. During the operations of cutting and building, there are many strict rules that should

Figure 27.—Cutting down.

be adhered to and which are common in most repairs. To a great extent, the success of the repair depends on proper diagnosis and on cutting without injury to the tire in appearance or strength. Almost any workman can, with a little practice, build up a tire by following the steps laid out, but it takes a good workman to get the job ready to meet the conditions of changing or adding a combination of repairs.

GENERAL RULES FOR CUTTING DOWN

1. Have all tools sharp and available at the bench.
2. Decide on the kind of repair to be made before cutting into the tire.
3. Junk all tires with badly broken side walls, loose or separated fabric all around, broken cables, rim-cut all around; or, in fact, any tires showing injuries or abuse that would make the repair cost more than the mileage to be had.
4. Have all tires thoroughly dry for good work. Drying can be done after cutting.
5. Remove all dirt and dead or wet fabric in a tire. These will cause friction.
6. Entirely eliminate or step down the injury, so that no hinge is left in the repair.
7. Aim to remove or step down all but two, or in some cases three, plies.
8. Step down all overlapped fabric or skive to a feather edge.
9. When cutting too deep, skive or feather edge the cut to allow cement to brush in.
10. Skive around the hole when two or more plies are left.
11. Round all breaks at ends to stop further breaking.
12. Wash all repairs with high test gasoline to remove oil, grease, etc.
13. Cut all tread splices at a 45 degree angle for good connection.
14. Aim to carry all cuts to the toe of bead, except the last ply, which should end at the heel. Exceptions will occur.

15. Cut all splices on non-skid tires at the highest point of tread for pressure when in the mould.

16. Never attempt extensive repairs on tires with mould pinches, buckles, etc.

17. When tread layback is no good, replace with new tread section or one cut from an old tire of similar design.

18. Use only the best grade of gasoline in all work.

19. Sectional repairs that do not hold up are usually due to not stepping the fabric far enough back from the injury.

20. Never pull a tread away from a tire—always cut it. If it will pull from the carcass, it is also likely to loosen between the tread and breaker, which will cause trouble later.

21. Never cut fabric steps in the bead channel or center of tire. The former invites rim cuts, while the latter exposes a cutting edge to the other materials when running.

22. Make reliners and blow-out patches from old tires. A good vulcanized reliner is worth three commercial cemented reliners.

23. Never cut away good tread laybacks. They will wear as long as the rest of the tread.

24. Make single laybacks when possible; double laybacks when the tread is broken across.

25. When loose fabric develops after cutting a section, enlarge the section in order to eliminate the loose fabric, or junk it if this is impossible. Loose fabric at the end of a repair will cause the downfall of the work.

26. When cutting down for retread and using new gum, keep the tread line up as far as possible.

27. In making a layback on narrow-tread tires, cut the layback wider, so as to be the same as if tread line was evident.

BUFFING RULES

1. Always buff both inside and outside of the repair, taking away the dirt, soapstone, and dead material. In all cases carry the buffing over the repair to rough the tire so that cement will adhere readily.

2. Rough all splices and parts on which new gum will be placed with a rasp or tack rasp. Also rough retreads, especially cords, until the cords shine.

Figure 28.—Buffing.

3. If the buffer does not reach all points, use a scraper or knife and soften with gasoline.

4. Remember that buffing is as important as any part of the repair.

5. Buff inside three inches longer than the job, ready for inside section or reinforcement.

CEMENTING RULES

1. Have the repair perfectly dry for applying any cement. It will not dry otherwise.

2. Two coats are applied. Each is allowed to dry fully, the time depending on weather conditions and the kind of cement used. Good results are obtained by mixing the first coat a little thinner and allowing it to dry one to two hours, the second coat drying about two to four hours, or until tacky.

3. Good vulcanizing cements should be cut two to one. One gallon of gasoline to one gallon of cement, making two gallons.

4. Always brush the gasoline about one inch over the repair on the outside to allow for trimming, and about three inches over on the inside.

5. Should a small portion of loose fabric show up, run cement under it. Be sure it is dry.

6. Use only the best grade of gasoline in thinning or cutting cements.

7. Cement can be dried too long before the materials are added to it. It then loses adhesiveness by forming a crust.

8. Cemented tires should not be placed in a draft, as they will crust over and remain damp underneath.

9. Use only good cement or cushion gums when making cement.

10. When, by removing a misplaced piece of fabric, cement is pulled away from a job in a small place, re-cement in the regular way.

11. Vulcanizing cement is made by using one pound of cement or cushion gum and one gallon of high test gasoline. Cutting is hastened by later adding one ounce of alcohol. Stir regularly and slowly. Do not beat it too hard as this will cause a poorer grade.

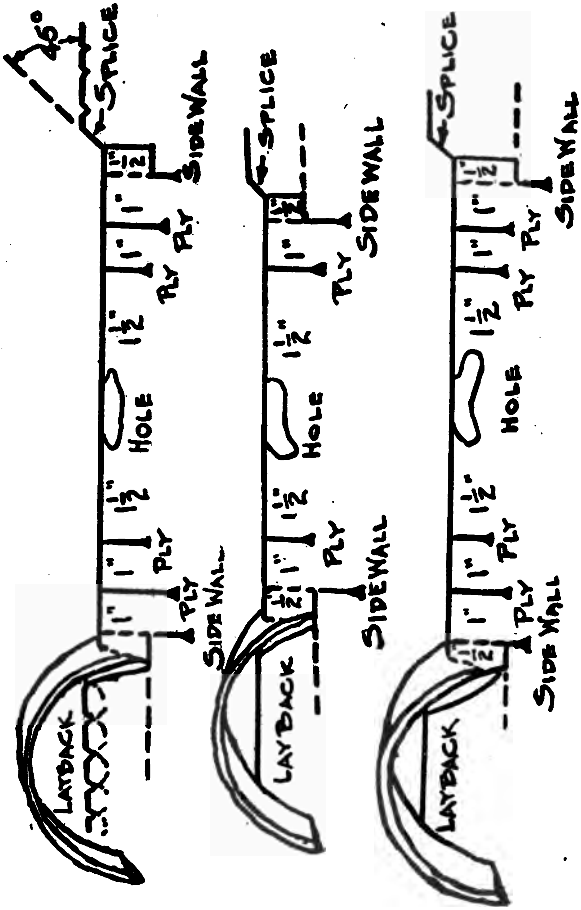


Figure 29.—Cord sectional measurements. Top—fabric, three inch motor cycle. Center—fabric, three inch airplane. Bottom—fabric, three, three and one-half and four inch regular.

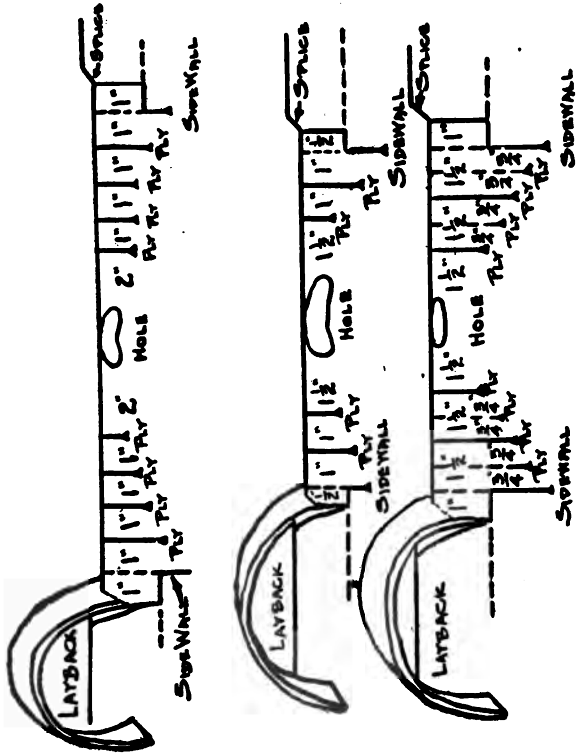


Figure 29.—Top—fabric, four and one-half and five inch regular Center—cord fabric, four inch airplane. Bottom—cord fabric, four and one-half inch.

Plies of Fabric—In starting a repair, it is necessary to know just how many plies are in the tire, also to know the construction of the plies at the bead in order to cut the plies out. Knowledge of the number of plies is necessary for marking off the section a certain number of inches from the end of the injury in order to cut a splice for the start of the layback.

In the double layback method, the tread is cut through the injury, either straight across or diagonally. Some repairmen remove a narrow strip about two to three inches wide, but the writer does not favor this method except in cases where the tread is already cut across, or on cable cord tires where a complete carcass foundation is made in the tire.

The reasons against the double layback are plain, namely: there are two or more plies under the splice in the center which has to be filled up with cushion gum or to which the overflow runs. Cushion gum is more pliable and yielding than fabric, and the result is that, when the repair is completed, there is a yield or push-in at the splice every time the tire turns on the ground. This movement will in time open the splice. This same result is found in all repairs where a hole is merely filled up with cushion or tread gum, which, when opened, is found to be ground to a powder or a fine mass. If the splice is started on the solid carcass of the tire there will be less yielding under the joint and it will last longer.

Should the number of plies removed be past the core center, take a ply from the inside.

It is from the following table that all marking off is done on the fabric section. It is to be noted that on all fabric tires:

Two plies are removed for either outside or inside sections up to 4″, inclusive,

Three plies are removed for either outside or inside sections for 4½″,

Four plies are removed for either outside or inside sections for 4½″ and 5″, which allows the last ply removed to be at least 1½ to 2 inches from the edge of the injury in order to give good holding surface.

SCALE OF PLIES TO BE REMOVED IN FABRIC TIRE

In sectional work from outside.					From inside.	
Size	Kind	Has No. Ply	Remove Ply	Measure for Splice	Re-move Ply	Measure for 1st Cut
3″	Motor Cycle	2 to 4	1 to 2	4″	1–2	4″
3″	Regular Tire	3 to 4	2	4″	2	4″
3½″	Regular Tire	3 to 4	2	4″	2	4″
4″	Regular Tire	5 to 6	2	4″	2	4″
4½″	Regular Tire	6	3	6″	3	5″
5″	Regular Tire	6 to 7	4	7″	4	6″
5½″	Regular Tire	7	5	7″	4	7″

For Any New Tire—For any and all repairs to a tire, a careful study of the cross section will show the ending of the plies or cords at the bead, and the construction will enable the repairman to immediately determine the repairs required and how needed.

ENDING OF PLIES AT BEAD

After the section has been properly marked off and cut for an outside section, the repairman encounters the various bead constructions and the ending of the plies which must be taken into consideration as the section is cut. In order to prepare the workman to make the cuts correctly and in order to remove the plies correctly, it is necessary to know this construction at the start.

There are tires constructed with a bead cover or chafing strip, while others have none. In some cases Q. D. tires are made by adding a false bead held on by the bead cover alone. This is often found in clincher body cord fabric tires of recent construction. On some tires the plies do not end at the toe or heel in even plies, but are either brought over

Figure 30.—Marking the section. 1 (right)—splice to be cut at this point. 1 (left)—extend lay-back to clear 2. 2—one-half inch from 1, remove sidewall and bead cover. 3—one inch from 2, remove first ply to toe of bead. 4—one inch from 3, remove second ply to heel of bead. 5—injury one and one-half inches from 4. It is only necessary to extend splice on inch for every extra ply to be removed in larger tires.

from the inside and carried up the outer side wall, or brought down over the bead from the outside and carried up inside of the tire. This will be found in the Dunlop S. S. types and in many heavy-duty tires. The reason is to give a wrap under the cable which

holds the bead and in which a rubber core is not found.

With Bead Cover.—Remove the bead similarly to a ply and build into the bead when replacing the fabric.

No Bead Cover.—Cut the first ply off diagonally on the side wall. Then come down and remove the ply as if it was the bead cover. This allows for dropping the last ply of fabric into the step for an even repair and still carries it well out on the tire at the top.

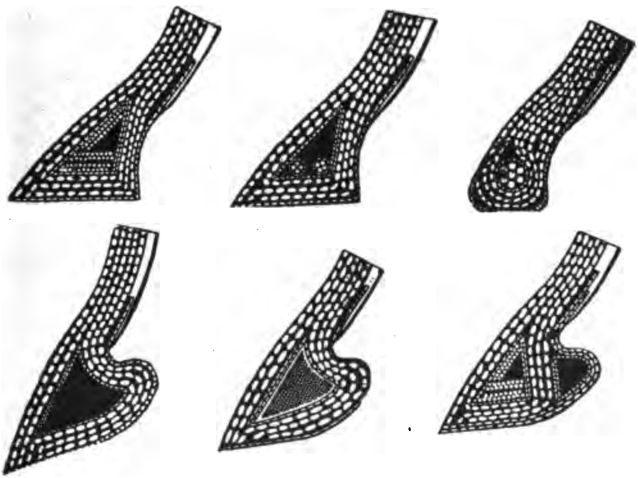


Figure 31.—Construction of beads. Top, left to right—straight side; straight side with cable base: dunlap straight side with cable center. Bottom, left to right—soft bead clincher; hard bead quick detachable clincher; quick detachable clincher with false bead.

With False Bead.—When this bead is encountered, cut off a splice between the bead cover step and the first ply of fabric and lay the false bead back. Then continue the steps as if for a S. S. tire. Build on the last ply over the bead after the other plies have been applied in their places.

Dunlop Types.—When the ply is encountered coming up the side wall, split between the steps and lay back, building up again when the ply is laid in to replace the injured ply.

Types in cord fabric are shown under operations on that type of tire.

Many repairmen have various ways of ending their plies on regular standard tires when cutting down. Some end the last ply on the side wall, which gives fairly good service; others carry all plies to the toe of the bead, the advocates of this method claiming more strength.

The most practical ending, however, is to carry all plies to the toe of the bead when possible, except the last one off, and cut the last ply off on the ridge of the heel. There are several good reasons for this, one being that three plies are replaced for two taken out. The bead is not made bulky and will fit the bead mould more easily, and it has been found that a perfect bead can be obtained. Another reason is, that the first ply can be immediately trimmed and put out of the way to allow the next ply to carry over. Still another reason is, that the tendency to allow the fabric to bridge the bead is overcome, which means that the fabric is not worked down into the neck of the bead but frictions from the side over to the heel of the bead, leaving a hollow space.

The result would otherwise be that the fabric is creased and stretched, inviting, in some cases, a direct rim cut in the repair and in many others leaving a ridge in the neck. Another important reason for ending the last ply at the heel is, that should the bare core or cable be encountered, it is not being entirely exposed if ended at the heel.

As mentioned under tire construction, the parts of a tire met with are the high point, tread, tread line, breaker, cushion, carcass or fabric, side wall, bead cover or chafing strip, neck of bead or channel, heel of bead, toe of bead and bead core; also the anchor strip in some tires. With these parts thoroughly known, the workman will have no difficulty in proceeding through any and all operations which follow. Remember to be cleanly and pay attention to the small things. These are essential. Also, develop rapid workmanship, with neatness, and the outcome will be repairs outliving the tire itself and escaping the censure of the most critical.

When operations are duplicated, references are made to the similar repair.

BUILDING UP TIRES

In the building up of the repair it becomes necessary to replace such materials or make such additions as will again bring the tire into serviceable shape and with the strength of a new tire when cured and put in use. At the building bench will usually be found the foreman or workman who has acquired the combined habits of the expert; such as speed, knowledge of the trade, orderliness, and above all others, cleanliness; together with sufficiently careful work to deliver a smooth repair with strength for curing. All materials, and for what use they are intended, must be known by sight. As in cutting, there are general rules which cover the entire work and which should be remembered.

Figure 32.—Building-up; applying and stitching the fabric.

General Rules for Building Up

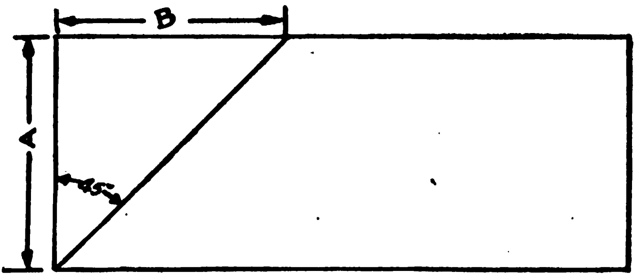
1. Remember that work done over is the outcome of carelessness, for which there is no excuse. It is either caused by poor workmanship, cheap materials, or improper inspection of the tire.

2. Locate the building and stock bench away from the buffers and steam bench.

3. Keep the benches dusted and orderly arranged at all times.

4. Have all tools as well as the hands and clothing clean and free from oil or soapstone. Leaning against a repair with dusty clothes will cause trouble if the work is not cleaned off.

5. Have the last coat of cement dried to tackiness (not hard) before starting work on any repair.



Sectional measurements.

6. Keep all materials on the bench covered when not in use.

7. Keep all stocks in a fairly dry place and hang on rolls. Never lay on the floor or on end, especially in warm weather.

8. Cut all fabrics on the bias, except breaker and bead covers, which are cut straight. Cut gums with the grain, if convenient.

9. When cutting to fit the steps, make even cuts (do not rag), and allow to overlap 1/16 inch on the steps, laying straight across the tire.

10. Trim all selvage from fabrics and barebacks, as it will draw under heat and cause a bind in the repair.

11. Should gums stick to holland or cloth, wet the other side with benzine or good gasoline, and pull away. Save all holland and cloth for shop use.

12. Butt bareback when connecting and strip with cushion gum one inch wide.

13. Lap fabrics one inch when connecting and stitch down well.

14. Stretch all fabrics under even tension when applying, starting from the center of the fabric and working out. Do not pull so hard as to pull side wall out of shape.

15. Use up all small pieces of fabric and gums in reinforcements or patches when possible. Actual scrap should be placed in covered boxes and kept separate for recalendering or to return for credit.

16. High grade gasoline is used to remove dust, oil, sweat, and bloom from stocks and is always used to wash the top cushion before the tread is brought down.

17. If possible do not place a fabric splice over the hole when applying the first ply, and never carry a splice in fabric over the bead. Cut it so it will butt on the bead.

18. If a knife dipped in water is used for trimming, be sure to wash the moisture away with gasoline and allow to dry before applying more materials.

19. Always use a gum on the outside work that will match, when cured, with the colors of the tire.

20. Careful stitching and rolling should be done at all times.

21. Use narrow strips of scrap fabric for strapping the tire to the iron mandrel by placing them at the ends of the repair in order not to pull away the cement when removed.

22. Make all applications of gums or fabrics smoothly and evenly. Use the roller when possible, as the stitcher has a tendency to rough or make a repair uneven on flat surfaces. Unevenness is the cause of many failures.

23. The general building rule is to replace plies as taken out, carrying the first ply to the heel and trimming and others to the toe if possible. The last ply should be carried over inside the tire to come under the reinforcement for strength and a neat appearance at the bead. In taking the ply over the bead, stretch tight at the toe.

24. Never build or run materials below a cement line. Keep above, as the flow will not adhere to a plain surface and will start loosening of a repair although apparently smooth.

25. Fill all holes in the carcass with cushion gum before applying fabrics. Cover all tread splices and patched surfaces with a layer of cushion for adhesion between new and old tread gum.

26. Misplaced fabric, when pulled away, ordinarily takes the cement with it. This should be recemented in all cases.

27. Never skive or bevel coated or cemented fabrics, as it exposes dry cotton to which gum will not adhere unless recemented.

28. Always gum-strip or seal fabric ends when applied to a repair.

29. Never let fabric bridge the channel of a Q. D. tire when building; work it down the side wall into the neck with the stitcher until snug in the groove before allowing it to touch the heel of the bead.

30. When carrying plies over the bead, trim to fall into the steps at the bead so that a smooth bead is the result. In order not to leave space, the last ply on can be stretched out over the bead cover cut after passing the heel.

31. Some repair-men butt all plies when applied; however, the 1/16 inch lap is better, as there is a shrinkage to the cured fabric.

32. Large diagonal tears completely across the tire can be stitched with bead fabric cut straight to hold the repair in shape on the mandrel.

33. Never fail to place cushion gum on top of a repair before bringing the tread down. The cushion is to be wider than the tread and up to and under both ends.

34. Perforate any and all blisters which appear under gums when rolling. Always perforate laybacks, retreads, and new gum-tread section to allow air vents when curing.

35. Non-skids can be added with new gum in tread sections, or a like tread section can be cut from an old tire and applied if of good live material.

36. Never use too much cushion gum or surplus tread gums in a repair. Cushion gum will flow. Tread gums and fabrics must be placed and trimmed to set.

37. When a repair has been completed and perforated, use a large pressure roller to thoroughly unite the repair into a solid mass. This might not be done by hand.

38. After rolling, trim away all surplus gums even with the tire lines and in such a manner that a feather edge will not be exposed to the road.

39. Some repair-men use old fabric from junk tires, which is buffed, cemented and applied in place of new material. Boot reinforcements are also made in this way. While it can be done, a good repairman knows that a partially dead fabric is being used and that loose spots are likely to be in the patch to start friction.

40. When building cord fabric tires or cable cord tires, endeavor to use the manufacturer's material of which the tire is made.

41. Cord fabric tires can be rebuilt with common fabric

by using one ply of common fabric to each two removed in light cords, or ply for ply in heavier cord fabric. Never use common fabric in cable cord tires.

42. In applying cord fabric, run the cords in the same direction as the ply cut out.

43. When bead cores are not available, they can be built up on Q. D. tires from strips of fabric and the bead cover applied.

44. Do not pull against the cross threads on cord fabric. In this fabric, start at the end of the repair and pull lengthwise on the cords, working into place in that manner.

45. In building airplane tires, the regular mandrel should be padded in the center to meet the contour of the tire, or a wood mandrel made of a proper circle. Airplane tires are of a thinner carcass or shell construction than fabric tires.

46. Do not build retreads down the side wall too far, as it makes the wall heavier for the set-up in curing.

SCALE FOR CUTTING MATERIALS

The cutting of fabrics in order to save material is a matter of practice and attention to tire sizes. Recent tires having an oversize capacity should be considered and the larger size cut. In all cutting, allow only such waste as required to have material enough for pulling properly into place, which need only be one inch greater at each bead, the 1/16-inch lap being added when fitting the steps.

For complete section with regular size shown below	Width of fabric to be cut on bias		Width of cushion gum 1/32″ thick	Width of breaker when used. Cut straight	Width of one side wall of 1/16. Up to 5″ tire. Double over.
	Inside	Outside			
3″	9″	10″	3½″	2¼″	1¼″
3½″	10″	12″	3½″	2½″	2¼″
4″	10″	12″	4½″	3″	2½″
4½″	12″	14″	4½″	3¼″	2¾″
5″	14″	16″	5″	3½″	2¾″
5½″	14″	16″	6″	3¾″	3″
6″	16″	18″	9½″	5½″	4″
7″	18″	20″	11″	6″	4½″

The above table is given to allow for waste in applying and stretching. Practice will enable the repairman to cut his fabrics approximately one inch less on every-day work and to use the size smaller for the first ply on.

In cutting fabric on the bias, or on a 45 degree angle, it is only necessary to have the end of the roll square. Measure the width of the fabric and measure the same distance along the fabric on one side. Rule from this point to the corner of the fabric, as shown in the drawing. Some workmen cut the material as needed, but a saving can be made by cutting, splicing, and rolling strips of the small sizes and using as required, the roll being rewound on the stock rack out of the way.

In placing the tire on the building mandrel, always be sure that the proper size form is used. The tire is strapped and shaped by the use of a strip of scrap fabric tacked to one side, brought under the form and pulled up tight to be tacked against the other side of the section and outside of the steps. It is for this reason that all repairs are slightly over-cemented, which allows a narrow space for attaching straps so that the cement is not pulled away from the repair. This also gives extra surface for applying side walls to be trimmed later.

For inside repairs, the tire is hung up and the side walls spread apart by wooden or metal blocks and the material applied.

REBUILDING FABRIC TIRES OF ANY SIZE

This repair is fast developing for advanced work on tires which require a new tread, a section, a rein-

forcement to the carcass, or perhaps a new ply or two to replace inner or outer loose or broken plies. New breaker, cushion, or side walls can be added. Usually the repairs consist of a new retread and a reliner made from the carcass of a tire, which is cured in. For good service, the repair must be correctly

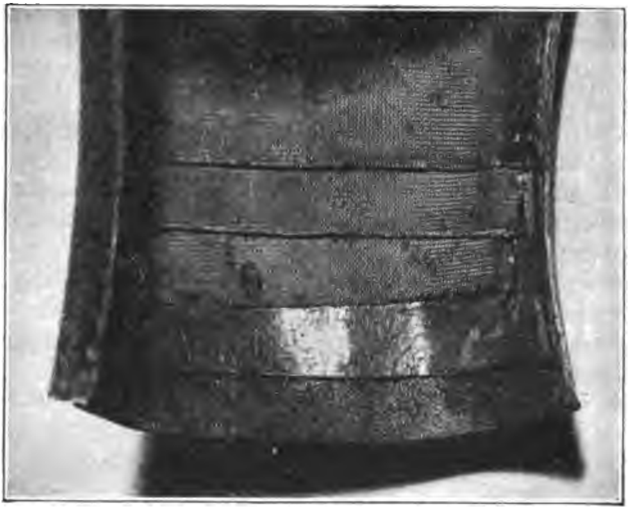


Figure 33.—Rebuilding; three ply inside build-up to be fully cured.

made and completely cured without buckles or loose spots. It is folly to add a good tread and then cement in a reliner. This repair can be cured in the sectional mould or on special equipment.

Cutting Down

1. Remove the old tread, including breaker. Keep the tread line well up.

2. Side walls can be removed if necessary, as can bead covers.

3. Remove or cut out all dead or loose fabric.
4. Step down a section for a blow-out if found.
5. Skive down any and all nail holes.
6. If broken fabric is found on the side of the tire, remove the broken or loose plies.
7. Prepare a reliner of one or more plies from an old tire for making an inside reinforcement of the tire.
8. Buff well and cement two coats.

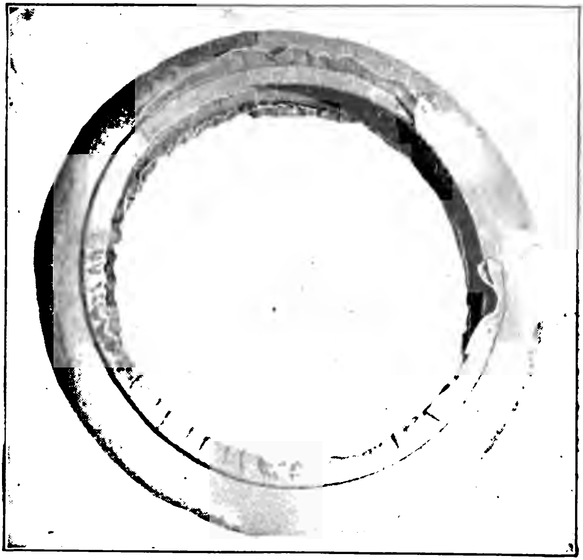


Figure 34.—Outside rebuilding.

Building Up

1. Cover all holes or fill with cushion gum.
2. Replace the fabric removed, lapping well and stitching evenly and straight. Gum strip all splices and butt the ply if carried over the head.
3. If in an outer rebuild, allow for the last ply to be carried inside the tire so to come under the reliner reinforcement.

4. Apply cushion gum entirely around the tire and wider than the tread to be added. Roll and stitch well, perforating for air blisters.

5. Apply a strip of breaker around the tire and stitch down well.

6. The bead cover, if removed, is now added to come one inch above the bead channel and around and slightly inside the tire.

7. Apply side walls on both sides, starting them about one-fourth inch above the bead channel and carrying up to come under the tread.

Note: On rebuilds, the size of a tire can be inlaid in the side wall, as can the name. This can be done by curing darker or lighter gums and cutting out the letters. Cement and apply to the side wall, stitching down well. They will cure into the side wall evenly if kept down below the tread line when in the mould.

8. Apply retread band or new gum as in retreading.

9. Turn the tire and fill all inside cuts with cushion gum.

10. Insert the prepared reliner (or apply new fabric) for increased strength in the tire and trim at the toe of bead. When inserting the reliner, it should be evenly set and stitched.

RECOVERING FABRIC TIRE OF ANY SIZE

This repair is made to replace old treads, side walls, cushion, breaker, and in some cases a bead cover on the outside only. It is cured in the sectional mould or by special equipment.

Cutting Down

1. Remove the old tread and breaker as for retreading.
2. Remove or buff away the side walls. Remove bead cover if necessary.
3. Block over or remove all dead or loose fabric.
4. Buff well and cement two or three coats and allow to dry to tackiness.

Building Up

1. Fill all cuts or cover breaks with cushion gum.
2. Apply fabric to all steps or block-outs, lapping well.
3. Apply bead covers if they have been removed. Allow

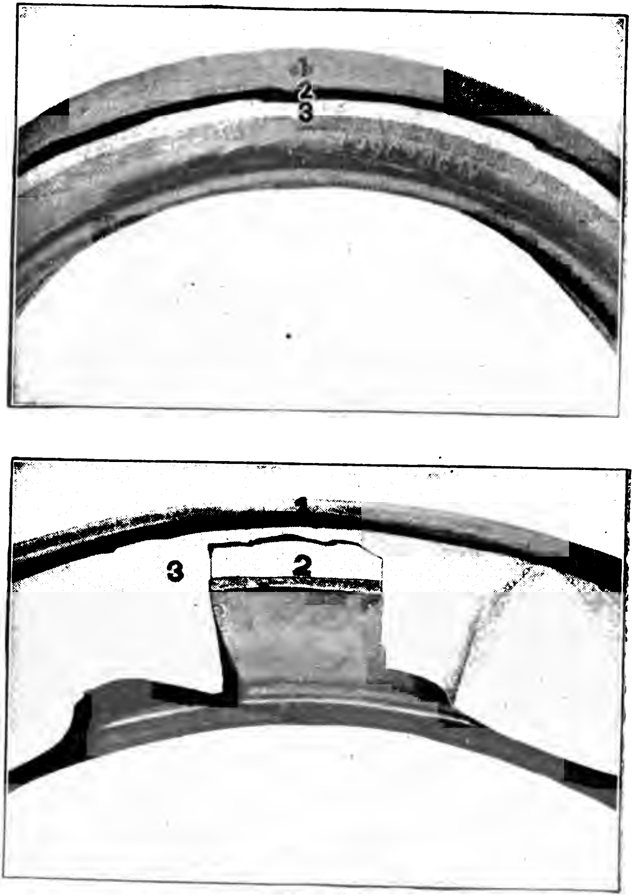


Figure 35.—Top—cutting for retread. Bottom—building up retread. 1—band. 2—side strip. 3—muslin.

them to come about one inch above the channel of the bead and to the end at the toe of bead.

4. Apply side walls, starting one-fourth inch above the bead channel and bringing up under the tread line.

5. Apply cushion, breaker and tread as for retread.

RETREADING FABRIC TIRES OF ANY SIZE

This repair is for replacement of worn, cut, or loose treads by replacing with raw gum or retread bands. It is used when the carcass is in good condition. Such minor repairs as are deemed advisable are made at the same time in order to put the tire into service within reasonable cost. It is cured in the sectional mould, retread kettle, or by special equipment. The retread is merely the replacement of the outer wearing surface of the tire, and no service can be had when loose fabric or a weak carcass is used.

The body of the tire must be in good shape with all loose fabric removed before applying the tread. Pliable treads cut from other old tires can be applied and good service secured. These, however, should be inspected and tested for dry breaker or loose spots before using.

Cutting Down

1. Mark the tread evenly with tread gauge.
2. Decide whether raw gum or a band is to be replaced.
3. If gum is to be used, cut under the tread line completely around the tire on both sides.
4. Cut through the tread and breaker and remove both from the tire by cutting, or by pulling if the old tread is not to be used again.

Note: If a band is to be used, the tread is removed one-half inch lower than the tread line to allow for the raw gum strip in which the new band is imbedded when cured. This strip stops feathering and varies from two and one-fourth to three inches above the bead, depending on the size of the tire.

5. Remove or block out all dead, wet, or loose fabric. At this point a careful inspection should be made for loose plies. Retreads will not stand up when applied to loose plies of fabric.

6. Bevel the tread line to a feather edge and rounding it.

7. The tire should now be thoroughly dried before cement is applied.

8. Buff well and rough the exposed surface slightly below the tread line on the side wall to allow the cement to take.

9. Wash with high test gasoline to remove oils or greases that may adhere to the fabric.

10. Cement two or three coats, allowing each to dry to tackiness. The first coat may be slightly thinner to allow for soaking into the carcass.

Many repairmen use three coats of cement, the first thin and the second heavy, drying each about one hour. The third coat is thin and is usually dried from five to six hours to become tacky. If the repairman has time, three coats of cement are recommended for all work.

The building up of retreads requires careful work and attention. Several methods can be used, namely: raw gum applied in layers, camel-back (built-up uncured gum) in the proper thickness, which can be made or secured ready for use, or semi-cured or fully cured retread bands. Some bands already have the breaker cured in them, while others call for a breaker to be applied to the tire.

In the selection of camel-back, it is essential that good high-grade gum be used. Many of the black camel-back stocks now on the market do not give the best of satisfaction. A good sheet gum properly built up will meet the mould conditions in most cases and deliver the best of satisfaction. The best cement cushion, breaker and tread gum is the only real way to eliminate future troubles with retreads. Price

should not be considered. Do high grade work and charge accordingly. Don't make comparisons with shops charging low prices.

Before building the retread, the tire should be carefully inspected for traces of soapstone, dust, etc., also for the tacky but not dry condition of the cement. Any and all places blocked out to remove dead or loose spots should be replaced with fabric well lapped. No soapstone or dust should be allowed to remain on

Figure 36.—Kinds of retreads, (left to right) sheet gum, camel-pack, retread band.

the band or the gums to be used. In fact, all bands should be carefully buffed, and washed with gasoline before cementing. Treads coming loose can be traced to insufficient cement, improper drying, poor cushion gum or poor buffing. Always use the best cushion gum and cement obtainable. All sectional repairs should be built up before applying the band or gum.

Building Up With Uncured Gum

1. Apply a layer of 1/32 cushion gum over the carcass, covering the tire slightly below the tread line. Roll well and perforate the air blisters.

2. Apply breaker strip at the proper width completely around the tire Cut straight and lap one-fourth to one-half inch at splices.

3. If breaker with frictioned side only is used, apply another cushion strip to cover the breaker and lap the sides one-half inch. Wash the cushion lightly with high test gasoline.

4. Apply layer after layer of tread gum in ½″ steps until proper thickness has been obtained. Center each ply and work out all air pockets, at the same time perforating well.

5. Cracking of tread line when camel-back is used can be overcome by gum stripping the tread line with a high grade 3/64″ tread gum.

Note: If desired, the step-up of ply is started above the tread line to allow the last ply to cover the whole and come down to, or slightly over, the tread line Too much gum should not be applied near the tread line, and at all times should be trimmed above the roughed and cemented surface so that any overflow of gum will not come in contact with the smooth side wall. This, in time, would start to feather or loosen up.

6. When all air blisters have been removed, roll the tire well, trim and rasp or buff smooth to make tire ready for curing.

Building Up With Retread Band or Camel Back

1. Apply cushion gum, using 1/32″ for fabric work and 1/64″ for cable cord tires.

2. Apply breaker if none is used in the band.

3. Apply two side strips one inch wide along the tread line to allow for trimming and for imbedding of band or gum.

4. When applying band, place piece of clean muslin around the tire. This piece should be about two to three inches wider than the band on each side. It will keep the band from sticking to the cushion while it is slipped over the tire and centered. Camel-back gum is applied straight with a splice cut, and is gum stripped. The camel-back is to be centered and stitched down. Use care in the stitching and rolling.

Figure 37.—Retread, showing two cushions, breaker and camel-back.

5. Center the band, using the center of the rib or non-skid feature as a guide (not the edge of the band). A rule or divider is used to measure from the neck or heel of the bead to the center used.

6. When the band is exactly centered, pull the muslin out from under the tread, without moving the tread as set. It is well to measure the band again to be sure that it is set correctly.

7. Thoroughly stitch and roll the complete band, starting from the center of the tire and working out to the edge to eliminate all blisters.

8. Perforate all air pockets that show up under the tread.

9. Roll the entire repair well on a large hand roller.

10. Trim, buff, or rasp rough places until smooth.

In some cases it is necessary to cut a retread band or splice to fit a smaller tire, in which case it is always cut on a 45 degree angle in the same way as for a sectional lay-back, and the splice is gum stripped with cushion gum.

RETREAD BUILDING INFORMATION

In applying layers of gum for retread, it is not necessary to build up as thick as when the tire is new. A 1/16″ ply less to the tread gum may be used, providing a good grade of gum is employed or if the one-third mould does not require it. The cutting of the tread ply to width depends entirely on the width of the tread that has been removed, which, however, should be kept well up on the tire for neat work and especially for convenience when curing in the moulds. No advantage is gained by having a thick tread coming down on the side walls, and gum is being wasted. The following scale gives approximately the number of plies and widths to be used in applying raw gum for retread, either built-up or applied as camel-back.

Scale of Retread Widths

Size	Plies		2nd Ply	3rd Ply
3″	3	2¾ in.	3½ in.	......
3½″	4	2¾ in.	3½ in.	4½ in.
4″	4	3¼ in.	4 in.	4¾ in.
4½″	4	4 in.	4¾ in.	5¼ in.
5″	5	4¼ in.	5 in.	5¾ in.
6″	6	5 in.	6 in.	6¾ in.

Size	4th Ply	5th Ply	Last Ply On
3″	......	......	Last ply
3½″	......	......	to cover
4″	......	......	down to
4½″	......	......	tread
5″	6½ in.	......	line and
6″	7¼ in.	8¼ in.	for trim

A practical way of applying uncured gum is to cut the widths as required and build them up onto a camel-back band on the table. The overall ply is made slightly wider than the distance between the two tread lines. The band is then applied carefully to center, with all air blisters eliminated.

When using camel-back or sheet gum, the stock should not be stretched so that it is thinned out, but should be laid on evenly in thicknesses all around the tire.

RECAPING FABRIC TIRES

This repair is made when the center of the tire has been cut through to the breaker or in some cases into the fabric, such injury usually being caused by a fender bolt. In some cases a repairman will step out a narrow strip in the top ply of fabric, especially when a loose upper ply is found, or a top mould

pinch shows. This is done in order to eliminate the cutting edge formed, in which case a ply or two should be added inside. Cured in the mould.

Cutting Down

1. Cut out or trim the injured tread completely around the tire. If a narrow injury, the sides should be cut on a slant of 45°. Should a mould pinch appear it is best to remove the tread.

2. Block out all loose, wet, or dead fabric. This should

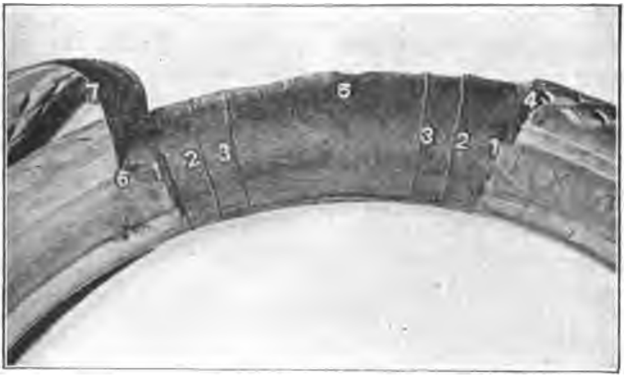


Figure 38.—Cutting the complete fabric section. 1—side wall and bead cover removed. 2—first ply of fabric removed to toe of bead. 3—second ply of fabric removed to heel of bead. 4—splice cut at forty-five degree angle. 5—injury skived to feather edge. 6—layback extended to clear side wall cut. 7—the single layback.

be done so to allow an overlap of the new fabric when applied.

3. Buff and cement two or three coats, allowing to dry to tackiness.

Building Up

1. Apply fabric to all block outs, allowing it to overlap well.

2. If the breaker or any plies have been removed, they should be replaced.

3. Apply the tread in the usual way, or, if merely for a tread cap, fill in with tread gum of the same color as the tire tread.
4. Roll well and perforate.
5. Before curing, trim or buff lightly for a smooth surface.

COMPLETE SECTION FOUR-INCH FABRIC TIRES

This is the most used of all repairs and is an outside job. It consists of a fabric replacement to a section of the tire and is made necessary by blowouts, deep cuts, or fabric breaks over one-half inch long, also by rotted fabric in the center of the tire. This repair can be made with a single or double lay-back, or with new tread section to cover tires, and with or without bead covers, false beads, or exceptional endings. It may be used with an inside section on every large tire to complete an entire repair. When the injury is in the center of the tire this repair is always used. Cured in the sectional mould.

Cutting Down

1. Locate the length of the injury or dead fabric by pushing a small awl through the end and toward the splice.
2. Place the tire on the cutting bench and insert the wood mandrel if one is used.
3. Mark the splice point and cut a splice at the highest point if non-skid. Cut at a 45 degree angle straight across the tread, using the table furnished for measuring a splice, for single lay-back. If using the double lay-back, or cutting out a tread section, cut through the center of the tire. Always go through the breaker. Place the tire flat.
4. The tread line is now opened up by use of the tread knife, the knife being dipped in water at intervals for easy cutting. Both sides are skinned up similar to removing the hide of a cow, always working towards the splice end until it is clear. It is then followed down the center of the tire until the tread has been laid back from the injury one inch farther than that of the splice end, which allows for the bead cover cut to clear the tread.

Hook the tread back with lay-back hooks. Place the tire on a shelf.

5. One and one-half inches from the base of the tread, start the first ply off and carry the same distance on other end of section. When this is removed in strips, start one inch in and remove the second ply on top of the tread, this being one inch closer than the other end of the section. This is called blocking out and lines up the section. Place the tire flat.

6. One-half inch from the base of the splice on both sides, remove or strip the side wall by cutting straight to the bead; also do the same at the other end. It is neces-

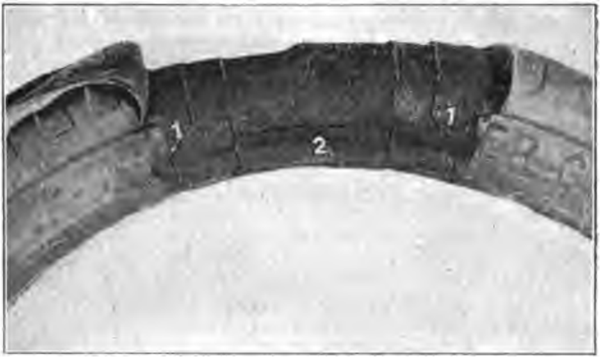


Figure 39.—Cutting down section (no bead cover). The first ply off is cut over to the bead line and then over bead. In building, apply three plies the same as if a bead cover were used.

sary to remove only about two or three inches of the side wall at each end, as the rest will pull off with the first ply of fabric.

7. Now follow the side wall cut down and remove the bead cover, if any, on both sides of the tire. If exceptions occur, see *"ending of plies at bead."*

8. The first block-out is continued down the side walls, keeping the steps even, and is carried over to the toe of the bead, removing on both sides together with the balance of side wall.

Note: It may be stated here that there are not three repairmen in ten that learn at the start how to keep step cuts straight with the tire. Some toe them out, while others bring them in, trying to conform to the bend of the tire. There is a decrease in the arc or circle at the bead from that at the top of the tire, but not sufficient to warrant toeing the step in or out. This fault is immediately overcome if the repairman will take the opposite side of the tire as an object to cut or aim to. Every cut down a side wall is merely an imaginary operation of cutting the whole tire in two. If this is remembered, perfect side wall cuts will be had on every repair.

9. The second ply out is then followed down both side walls, keeping the steps even, and is ended at the heel of the bead. This, as stated, is the last ply off.

If three plies were removed, the first two would go to the toe of the bead and the third would end at the heel of the bead and so on. Exceptions will be met with, as in bead exceptions. For example should a Dunlop type be encountered, split the ply ending up the side wall and pry back to hang. The second ply off would then be removed in the regular way.

Note: The steps from both sides should meet evenly on both toes of the bead. When cutting the second side it should be lined up with the other side.

10. As there are now two, or perhaps three, plies left around the injury, it is necessary to skive or slant all sides of the hole to a feather edge. Also round straight breaks to stop further splitting when built up and cured.

11. Trim all tread holes or cuts in the tread preparatory to buffing and cementing.

12. Buff inside and out by following buffing rules.

13. Rasp and rough the tread splices wherever new gum is to be used. Wash with highest grade gasoline inside and out.

14. Cement two coats and allow to dry while hanging out of dust or draft.

The foregoing steps are the exact operations in seventy-five percent of tire repairing. The repairman very easily adapts himself to reducing these steps to three moves of the tire, namely: the top work, removal of one side wall, and the removal of the other. Some repairmen even go so far as to cut all the steps

at the ends and pull the entire repair; this, however, is a waste of strength and no time is gained as the

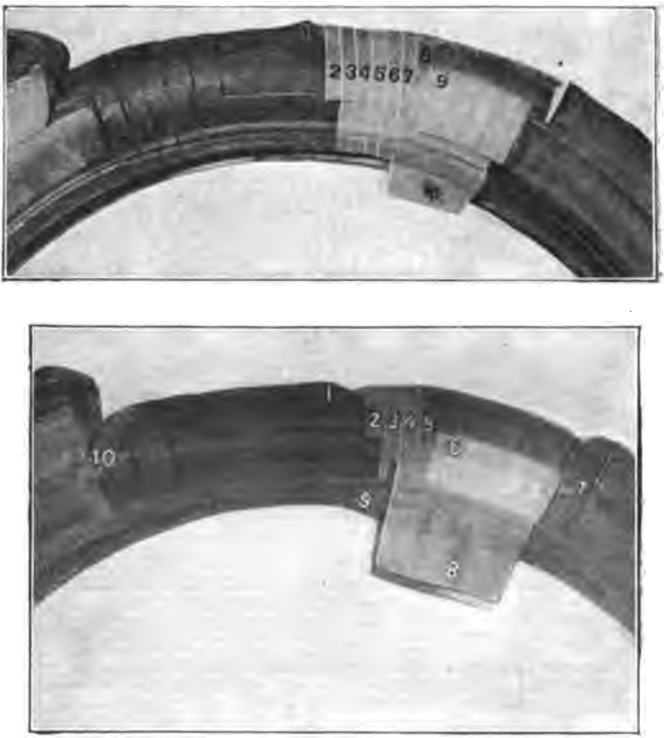


Figure 40.—Top, complete section, five inch tire. Showing cut down and build up when plies run under the bead core. Bottom, complete section, Dunlop type. Overlap ply 9, is laid back; ply 3 is built under. End the ply on side wall if under the bead core.

fabric can be cut in strips and removed just as quickly and the workman is better able to stand the

strain, as cutting down tires is the hardest part of the trade.

Building Up

1. Inspect the condition of cement and tire. See that no drops of wet cement are in the tire, as they would cause a blow. If dry to tackiness, strap the tire to the proper size mandrel.

2. Apply flat strips of cushion gum to the injury, overlapping slightly until even with remaining plies.

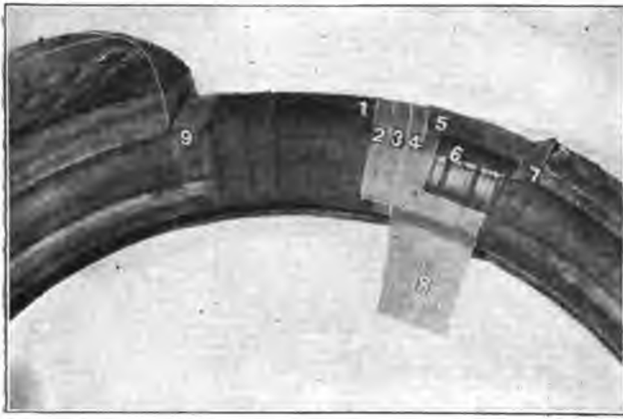


Figure 41.—Building up the complete fabric section. 1—injury filled with cushion gum. 2—first ply of fabric to heel of bead. 3—second ply of fabric to toe of bead. 4—third ply of fabric to extend inside tire. 5—cushion cover applied under tread. 6—side walls applied. 7—cushion gum placed on splice. 8—cushion butted up over layback.

3. Cut fabric from ten-inch strip and of the same length as the first step out, allowing 1/16 inch at each end for overlap. Crease the fabric in the center for the top line and apply to the step. Roll down with roller, stretching at the same time, and see that it follows the step down the side wall evenly. Use stitcher in working the fabric down the bead channel to the heel of bead on both sides, then trim.

4. Cut second ply from 12-inch strip to fit next step

with the overlap and apply in the same manner, carrying over the bead to the toe, where it remains until the tire is turned for inside work, being then trimmed to fall in steps at bead.

5. Cut third ply from 12-inch strip or wider, and apply in same manner, fitting it over all so as to be about one inch past the last cut-out, and so that it follows the bead cover line snugly. This ply is allowed to remain to be carried inside when the tire is turned.

Note: Some repairmen use only two-ply back, in which case the first step is left and the remaining two are as shown. Others may end a cut on the side wall and build over to the heel. However, these exceptions should not be used unless by instruction from the owner of a shop desiring an operation of this kind.

6. Cut cushion gum about six inches wide and long enough to cover the entire repair. Butt up against the tread layback and pull section up over the splice, where it is turned down just on the splice for filler and flux. Stitch the cushion under the layback end.

7. Cut two strips of 1/16 inch tread gum of the same color as the side wall, each strip two and one-half inches wide and of a length to lap over the old tread at each end of the section. Apply slightly above the bead channel and roll down well. Skive the top to a feather edge. Do not trim ends until the tire has been rolled.

8. Wash the top surface of cushion lightly with good gasoline for removal of accumulated sweat or dust and see that no dust is on the tread layback.

9. Back up any holes in the tread layback with cushion gum and pull the layback down on the tire evenly so to fit perfectly at the splice. Hand roll well and see that cushion at splice fills evenly.

Note: Should it be necessary to place new tread section, see operations under "*tread section.*"

10. Fill up all cuts on the outside of tread with gum of the same color, which has been cemented and properly prepared. Make slightly higher than the tread line.

11. You are now ready for the reinforcement, which is used with all repairs of this kind.

Reinforcing the Section

a. Place the tire on the hanging hook and spread for inside work.

b. Stitch the second ply on to the toe of the bead which was left, and trim.

c. Stitch the last ply on over the toe of the bead and down inside the tire, pulling tightly at the bead and fitting perfectly.

d. Cover the injury from the inside with cushion gum and stitch.

Figure 42.—Reinforcing the section. 1—injury filled with cushion. 2, 3—fabric ply placed.

e. If a small hole, cover with a piece of scrap fabric and stitch down well. If large, put in a ply of fabric the same size as the last ply outside. Stitch this fabric well, trimming with stubbing knife

about one-half inch from toe of bead on the solid bead.

f. Cover the whole with a piece of bareback (or fabric) from bead to bead, cutting the bareback one and one-half inches longer at each end than the last ply on the outside. This protects the tube and also increases the strength in the section.

12. Roll the repair well with hand pressure roller, This unites the entire repair.

13. Perforate the tread for air vents in curing.

14. Trim away all surplus gums, making the repair smooth, and grind down or rasp the gums evenly.

The tire is now ready for set-up and cure at the steam bench.

Note: In making the same repairs for larger fabric tires, a similar procedure is followed. In some cases a ply is ended on the side wall with one at the heel and the rest at the toe as before.

THREE-QUARTER SECTION

Four-Inch Fabric Tire

Used for the same purpose and in the same manner as the complete section, except that one side wall is allowed to remain. Used for injuries near the bead or at one side of the center of the tire when small. The tread is laid back single or double and the bead cuts are identical with the foregoing and always reinforced. Cured in the sectional mould.

Cutting Down

1. The tread is laid back in the same manner.
2. The tire is now blocked out to leave the side wall away from the injury, cutting the first ply about one inch from the center of the tire on the side opposite the hole.
3. The second ply is blocked out one inch from the center of the tire towards the injury.
4. All other steps are identical with those for a single side wall cut in the complete section.

Note: This repair is made for a saving of material and

is practical. The point to remember is, that no ply is to be cut in the center of the tire; also, that in building up, two plies are going to overlap the first block-out past the

Figure 43.—Three-quarter fabric section cut down the same as a complete section. One side wall remains. Plies are stepped on either side of center of the tire.

center of the tire. Sufficient space must be provided for them to fit between the cut and the tread line without making a bulky job.

Building Up

The steps for building this repair are the same as for the complete section in every particular, except that the last two plies on end between the last cut off and the old tread line. Only one side wall is replaced. The steps end at the bead on one side in the same manner. The reinforcement is made complete in the same manner as for the section.

SIDE SECTION

Four-Inch Fabric Tire

This repair is usually made without completely removing the tread. The tread may be cut back and laid up on the tire or may be left alone. The repair is always reinforced. Bead cuts are the same as in other sections. Cured in the sectional mould.

Side sections are used for rim cuts and low injuries near the bead. They may be made by cutting under the tread, cutting a half splice at each end and folding back, thus allowing access to more carcass surface and also giving a bind to the fabric replaced. The three-quarter section is recommended for this repair unless quick work is desired or straight rim cuts of a short length are found.

Cutting Down

1. Locate the ends of the injury and measure one and one-half to two inches each way, allowing one inch more for every ply to be removed and an extra inch for side wall removal.
2. Remove the side wall and bead cover, if any.
3. Step out first ply of fabric two and one-half inches from the end of the injury and remove to the toe of the bead. Take step up side wall, but leave sufficient space for two plies of fabric to lap.
4. Remove second ply, if necessary, to heel of bead and about three-fourths to one inch below first ply. Cut on side wall.

5. Skive the injury.
6. Buff, wash, and cement inside and out.

The strength of this repair is made by carrying the last ply on over the inside of the tire and up on the inside wall.

Building Up

Side sections are built on the mandrel, replacing one more ply than the number taken out and with the sides of the fabric falling on the steps or above them when the tread is lifted back or cut away. The side wall is applied as before and the tread replaced or filled. In applying the

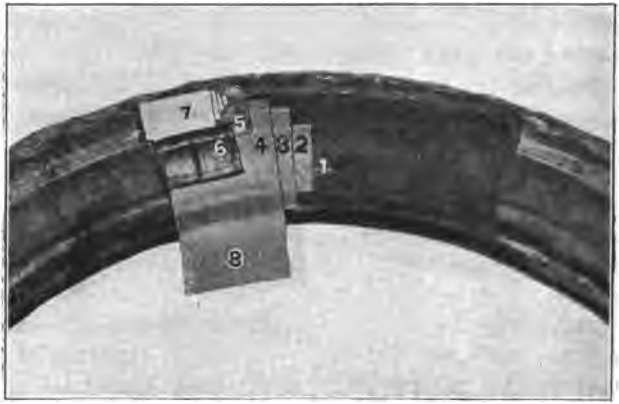


Figure 44.—Fabric side section. Tread can be laid back either with or across the tire.

last ply of fabric, cut wide enough to go inside the tire and lap the entire side wall for strength. This repair is strengthened with the complete reinforcement.

INSIDE SECTION

Four-Inch Fabric Tire

In this repair two or more plies are removed, and a tread repair is usually used in connection. This repair is a substitute for the complete or three-quarter

Figure 45.—Fabric inside section with injury skived to feather edge from inside.

section. It is recommended by manufacturers of equipment in which an arm and patch vulcanizer is used to cure the tread patch, and which is made for the outside treatment of the repair. It may also be handled in a sectional mould. It is the quickest sectional repair and requires less work than the outside method, also less material. A practical repair for small injuries if properly made.

Cutting Down

1. Trim the injury or bruise on the outside for a tread patch, skiving through the breaker till the fabric shows and far enough back to give a firm hold for the gum to be replaced. Do not let the new gum plug the hole, but let it cover.
2. Partly turn the tire and place on the shelf. Locate the length of injury, and measure four inches for the first ply out on each side
3. Remove this ply from bead to bead.
4. Second ply is removed in one inch step and must be ended between the bead channel and toe of the bead or above the channel. Never cut in the channel of the bead to invite a rim cut.
5. If three plies were to be removed, the second should end on the bead itself, and the third ply above the channel or neck.
6. Skive the injury.
7. Buff, wash, and cement, inside and out.

In large tires a combination of this repair can be used to reduce the number of plies around the cuts on the outside run under the bead core.

Note: Another method is to skive back from one to three inches, feather edging the injury on the inside in place of stepping out the fabric. Then build up in steps.

Building Up

1. Hang on hook and spread for inside work.
2. Inspect the condition of cement and the tire.
3. Cover the injury with cushion
4. Cut first ply to fit first step with overlap of 1/16 inch on each end.

5. Cut second ply of fabric to overlap the last ply out, which, if desired, can run out on tire for one inch. Apply to within one-half inch of toe of bead.

Figure 46.—Fabric inside section. Shows method of blocking out and building up with fabric ply.

6. Cut bareback to fit from toe to toe and one and one-half inches over each end of the last ply and apply.

7. You are now ready for outside treatment of the repair if through the tire.

REBUILT SIDE

Any Size Fabric Tire

A repair similar to the side section for a complete rim cut on one side. Cured in the sectional mould, on special equipment or a side wall vulcanizer.

Cutting Down

1. This repair is an extension of the side repair and requires no other steps.

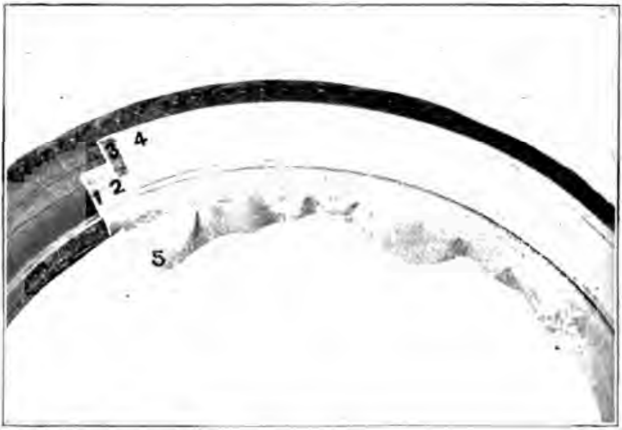


Figure 47.—Re-run side wall. Showing ply removed and build up.

Building Up

1. Apply fabric completely around the tire, allowing it to come up the inside of the tire as a reinforcement.
2. Place cushion gum over tread line if tread is affected.
3. Apply side wall as shown.

Note: A reinforcement of new fabric is not usually attempted in this repair. However, a reliner can be made of two plies and cemented and cured in at the time of

curing the outside repair. This will give satisfactory service to the tire.

RECOVERED BEAD

Any Size Fabric Tire

A replacement used for loose bead covers chafed from rim. Cured in sectional or side vulcanizer or with special rims. Sometimes used in rerunning side walls.

Cutting Down

1. Remove side wall entirely around the tire below or to the tread line.
2. Remove the old bead cover.
3. Repair rim cuts, if found, by stepping out fabric.
4. Buff, Wash, and cement outside only.

Building Up

Cut light bead cover of width to run from the toe of the bead and up just above the bead channel. Apply by stitching well. Apply side wall if it has been removed.

In large tires of the cord fabric type, two bead covers are usually used, and these should be applied. In some cases a heavy fabric bead cover is used. This depends on the make of the tire.

RERUN SIDEWALLS

Any Size Fabric Tire

Consists of placing new side walls on a tire having them worn or torn away. Cured in sectional mould, side wall vulcanizer or by special rims in the kettle. Unless other work is done, it is not used to any great extent.

Cutting Down

1. Remove the side wall entirely around the tire, below and up to the tread line.
2. Buff, wash and cement outside only.

Building Up

Cut side wall gum of same color and of sufficient width to cover the removed side wall and apply. Stitch well, keeping one-fourth inch above the bead channel. Grind down along the tread line until smooth, then cure.

BEAD SECTION

Any Size Fabric Tire

For replacing a section of bead core when broken in clincher tires. Usually done when sectional repair

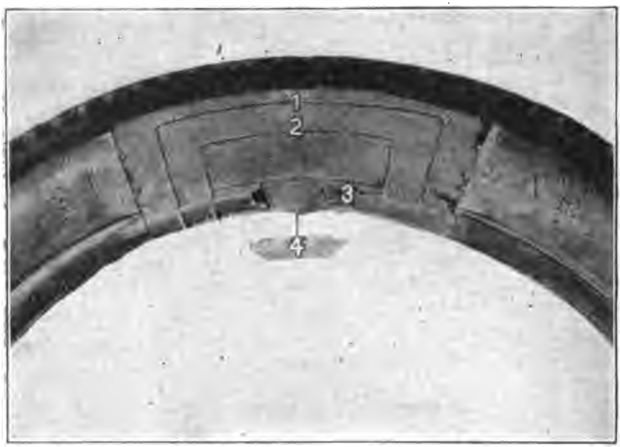


Figure 48.—Bead section. Replacing broken bead with section of bead.

is made. This repair does not affect cable wire beads. It is a sectional cure. This repair is the replacement of a section of bead in a rubber core clincher or Q. D. clincher bead.

Cutting Down

1. Make the regular sectional repair if required, or use a side section if for broken bead only.

2. Cut the old bead at a slant and fit in a piece of bead core from an old tire.
3. The object is to replace with exactly the same length of bead section.
4. Buff, wash, and cement inside and out.

Building Up

In this repair, the new piece of bead is inserted before the fabric is applied, for either the side section or otherwise. Cushion gum is placed over the splice ends and a light bead cover is used to set the new piece of bead into place. The balance of the work is part of a regular repair explained before. Bead can be made from fabric, if out.

TREAD SECTION

Any Size Fabric Tire

This repair is a replacement of part of a tread which is worn out, cut, torn or otherwise injured. It is always reinforced. Cured in sectional mould or sometimes with a patch vulcanizer on arm.

Cutting Down

1. Locate the extent of the loose tread.
2. Cut away tread, including breaker and any dead fabric, down to side wall or tread line.
3. Cut ends of old tread so that a 45 degree slant is secured.
4. Buff, wash, and cement inside and out.

Building Up

1. Place on mandrel and block in with fabric for replacement of dead fabric cut away.
2. Fill any holes with cushion gum, one layer thick.
3. Cover the entire surface with cushion gum, carrying up over the splices at end. Wash.
4. Apply breaker, cut straight, to fit up to old breaker.
5. Fill in with layer of tread gum of same color until slightly higher than the tread line. Allow each ply to lap over the end of the splice in order to trim for a good splice. Step up toward the center of the tire.

Note: Should you be using an old tread section from a

tire of similar design, see that it fits over the cushion evenly, that the splices are snug and the gum stripped.

6. Reinforce the entire repair from the inside with a large reinforcement, usually of two plies as in the complete section.
7. Perforate well and trim ready for curing.

Figure 49.—Tread section. Both splices are cut on an angle and covered with cushion in building.

TREAD PATCH

Any Size Tire

A replacement of a portion of the tread. Made necessary by cuts, jabs, or blow-outs. Always reinforced. Cured in sectional mould, with blocks or cores, or by special patch vulcanizer in manner similar to the tread section.

Cutting Down

1. Locate the extent of loose tread.
2. Cut away the tread and breaker, removing dead fabric, if any, for a distance around the hole.
3. Skive the hole to a feather edge.
4. Look inside the tire for dead fabric. If found, block out in small section.

5. Buff, wash, and cement inside and out.
This repair is merely a modified tread section.

Building Up

1. Fill the hole with cushion gum.
2. Replace with blocked fabric if dead fabric was cut out.
3. Cover the entire repair with cushion gum, one layer thick, on the splice sides.
4. Fill evenly with pieces of tread gum until slightly higher than the old tread and stitch down.

Figure 50.—Tread patches. 1—improper cutting. 2—good bevel from emery stone. 3—beveled splices cut with knife.

5. A small reinforcement is always used on this repair in fabric tires.
6. Roll, perforate and trim.

SIDE WALL PATCH

Any Size Fabric Tire

Same as tread patch. Used when the side wall is blown from a leaky tube or by being worn or cut away.

Cutting Down

1. Locate the extent of the loose side wall.
2. Remove the side wall.
3. Buff, wash and cement, inside and out.

Building Up

Replace the side wall in the same manner as a tread patch would be applied.

REINFORCEMENT

Four-Inch Fabric Tire

This repair is used as an inside backing for most other repairs and is a protection to the tube as well as for strength in the repair. It is also used to some extent in covering small breaks, nail holes, or dead fabric in the cases to prevent pinching. In these latter cases the tread patch should be used with it. This repair should not be confused with the inside section, as it is only a small fabric repair for nail holes less than one-half inch across.

Cutting Down, Small Reinforcement

1. Locate the extent of the dead or loose fabric.
2. Step out in sufficient blocks to allow one inch steps in all plies except the last, which should be one and one-half inches from the edges of the injury.
3. If the hole is through the tire, cut outside of tire for tread patch repair.
4. Buff, wash and cement.

Building Up

1. Cover the hole or injury with cushion gum.
2. Cover with a piece of square fabric to overlap any block taken out.
3. Cut bareback one and one-half to two inches larger and apply.
4. Roll, perforate the entire repair well, and trim ready for curing.

Large Reinforcement

For tread patch or section see "*Sectional Reinforcements.*"

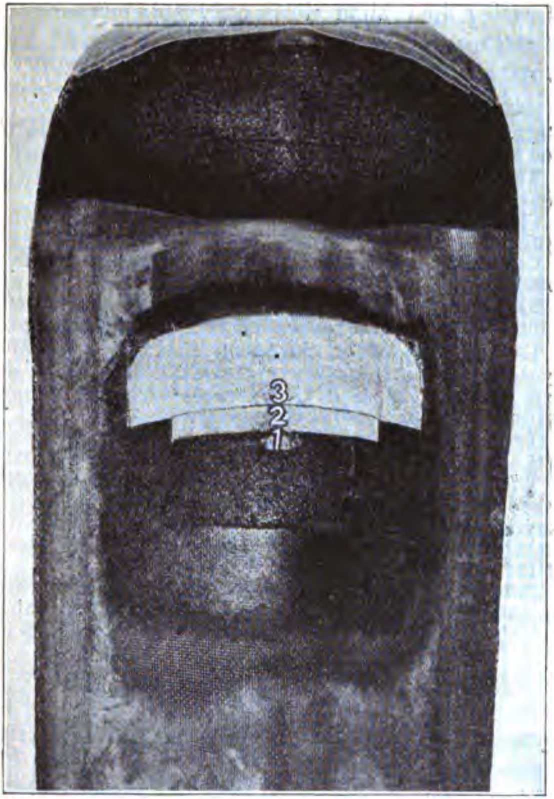


Figure 51.—Small reinforcement. Dead fabric blocked out and injury skived.

RELINERS

A complete reinforcement for the inside of a tire. Made of one or more plies of fabric when the inside is broken. Cured or used with cold cement. When

used with cold cement, it is only an emergency and cheap repair. If properly cured, it will add life to the tire.

Making Shop Reliners

Select a tire of a cross section larger than the tire to be relined and of same circumference.

1. Take the old tire and cut away the rubber on both sides at the tread line to the carcass.
2. Skive or slit the first ply entirely around the tire at both places.
3. Cut through the tread and pull the tread and the cap ply off.
4. Skive through the ply at sides and pull the two side plies off; in this manner exposing the entire second ply.
5. Lay the tire flat on the bench and step down in successive one-half to three-fourths inch steps, starting about one to one and one-half inches above the bead, pulling each step until the bead is exposed or removed.
6. Trim off the beads so to give a reliner slightly wider than the inside of the tire.
7. This reliner, in many cases being too thick, should be pulled down to the proper number of plies, as tire fabric is heavier than commercial reliner material: 3-inch tires, 2-ply; 3½-inch tires, 3-ply; 4-inch tires, 4-ply; 4½-inch and 5-inch tires, 4 to 5 plies.
8. Buff the tire thoroughly on the inside, also the reliner, and reinforce small holes. Wash and cement two coats.

Reliners, Shop Made and Commercial

These give protection to the tube and are a reinforcement to the case.

Reliners are now entering into the every-day work of the vulcanizer to a large degree, as it has been found that the cemented-in reliner is not an asset and does not increase the life of a tire. It is only a temporary reinforcement and when placed in the tire with cold vulcanizing cement or special reliner cement (cold) it immediately starts friction in the tire. In

a short time this friction softens and blows the tire out. A cemented-in reliner is, therefore, practical in only two cases; for temporary service or to place in a tire not worth repairs, but which may be used for some mileage. The cöld cements on patches or reliners will soften under road friction or heat. Reliners just placed in the tire, and not cemented in, will ordinarily pinch in the tube in a short time.

Tires that have been run flat may have broken only the inner ply or perhaps two plies. This same trouble may appear because of under inflation. With a perfect tread and side walls such a tire has unlimited mileage provided the broken ply is removed and replaced with a good fabric reliner, properly buffed, cemented and cured. It is practical to place a layer of cushion gum under the reliner. The curing may be done on the arm, by use of special equipment, or in the sectional cavity or mould. In other words, the reliner must be welded or cured to the carcass of the tire as part of the tire. This will remove any chance for friction.

The commercial reliner for inserting in the tire is composed mostly of ordinary patching cement and thin fabric. It generally has internal friction when inserted in the tire because of poor adhesion, although some companies make a good reliner. It is for the best interest of the repairman, when putting a tire into service to use a fully cured reliner or one made from an old tire. In the selection of the shop-made reliner, loose fabric must be looked for and such plies stripped off so that a solid reliner is used.

Inserting Reliners

Cemented-in reliners are inserted after cementing the inside of the casing and the reliner. This is done by spreading the tire apart, centering the reliner and working it completely around the tire. The reliner is stitched carefully from the center to the bead, where it is trimmed to fit smooth and snug to prevent pinching the tube. This method of inserting is a temporary repair for an emergency, and road friction will have a tendency to soften and loosen the reliner.

In inserting cured-in reliners, the following rules can be followed to good advantage. Those reliners can be cured in the sectional mould when curing a tread, in the kettle with an air bag or by a special endless steam bag.

1. Fill all cuts with cushion gum and apply fabric over all breaks stepped out.
2. Apply layer of cushion gum 1/64 inch thick over entire inside surface.
3. Insert cemented reliner made from old tire or one made for vulcanizing purposes (not a regular commercial reliner).
4. Stitch down well from center to toe of beads, and trim.
5. Cure under such shop conditions as are available.

Considerable difficulty may be encountered during the insertion of a reliner in order to keep it straight and without buckling. Practice, however, will enable a repairman to place them easily.

The tire can be turned and two strips of muslin laid over the sides, leaving the center exposed for about two inches. The reliner can then be applied and centered completely around the tire. The tire is then re-turned and the strips of muslin pulled out

as the reliner is stitched in place. The use of the muslin allows for the slipping of the reliner, which will cover more surface when the tire is placed back in the proper position. The muslin also eliminates the buckle which would occur if the reliner were allowed to adhere to the entire surface when turned.

Inserting Blow-Out Patches

These are merely inserted in the tire and over the break at the time of placing the inner tube. Should the patch have a flap, it should be carefully set to come outside the tire at the rim channel. An application of cold vulcanizing cement will give better adhesiveness to the patch, but they can be used only for temporary service, as such a patch will in time damage a good tire.

Making Blow-Out Patches or Boots

These are used as a protection on the tube from holes and cuts.

It is only necessary to cut a shop reliner into proper lengths, then step down the end to make a blow-out patch or boot. This patch is a temporary service replacement only, and will in time cause chafing in the tire. When cured in, longer service can be secured.

Special blow-out patches or boots of any length and of any thickness can be made in this manner.

Cord boots for cord casing repairs can be made of cord fabric and shaped on the arm. However, the manufactured article is well built and cured, being practical for the use required of it.

OTHER FABRIC REPAIRS

Repair shops have many methods of making repairs which are equivalent to a complete sectional repair, but in which a saving of material is figured on. Most of these can be classed as cheap repairs and are not recommended to give the satisfaction that can be had by completely eliminating the injury and building up ply for ply.

Filling up a space left by several thicknesses of fabric with cushion gum, or leaving off a step will not add strength to a repair. It may make a smooth repair, but in a short time the friction it causes will chew up this filler and cause another blow-out. For this reason the following are not listed for practical repairs, but only for cheapness and quick work when the casing is practically worn out and required only for a short time or a trip. A good repairman will never use them, as they leave trouble in the tire.

Ply Off With Boot Reinforcement

This repair is a substitute for the complete section and is used by some shops as a cheap repair. Possible for service if the injury is skived properly.

The tread is laid back as for the complete section. The side walls, including the bead cover, are removed. One ply of fabric is stepped out and the injury skived. The repair is then buffed and cemented. A fabric boot or blow-out patch is made from an old tire to fit the inside of the tire as a reinforcement, this patch being buffed and cemented.

In building up, the injury is filled, one ply of fabric added, and the cushion and side wall applied.

The tread is then brought down and the inside boot or reinforcement inserted.

Outer Fabric Layback Section

A repair substituted for the complete section, or, in some cases, for a side or three-quarter section. Its use in many cases does not affect the side walls when the injury is in the center of the tire.

The tread is laid back or cut away and the ply is

Figure 52.—Ply off with boot reinforcement.

stepped out about two and one-half inches from the injury, but not removed entirely. A strip as wide as the injury is removed and the two laps of the ply are laid back by use of the awl. A second ply is stepped out one inch closer to the injury, the center strip is removed, and the lap laid back. The injury is skived to a feather edge and a boot made to fit, the repair and boot being buffed and cemented.

Figure 53.—Fabric layback section.

When building, the injury is filled with cushion and a block of fabric cut to fit under the laps of the last ply removed. The laps are brought down and stitched. Another block of fabric is cut under the first ply laid back and these laps are stitched down. The entire repair is then covered with a block of fabric. Cushion is applied and the tread brought down. The reinforcement is inserted.

Tread Patch and Boot Reinforcement

This repair is often used in place of a section for small cuts or breaks. A tread patch is cut in the regular way and the injury skived to a feather edge inside. A special boot, made from an old tire, is cut to fit inside the tire from bead to bead.

In building, the tread patch is built up on the inside, the injury is covered with cushion, and usually tread stock filled into the injury. The boot is inserted.

Bias Cut With Boot Reinforcement

An inside repair in which the fabric is split diagonally four ways, then built up with blocks of fabric and a boot reinforcement. The repair is not recommended for good service, but is used by some small shops.

The first ply of fabric is split diagonally each way from the injury to clear four inches on each end, and the triangular laps are laid back. The second ply is split in the same manner and laid back about one inch closer. The injury is skived and a tread patch repair is made on the outside if required.

In building up, the injury is filled with cushion,

and blocks of fabric are fitted under the laps, which are then stitched down as each ply of new fabric is added. The entire repair is reinforced with either a boot reinforcement or bareback.

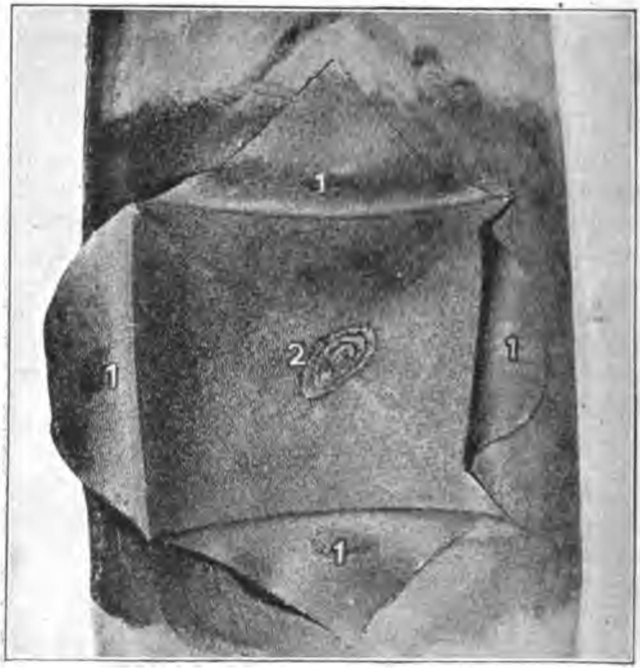


Figure 54.—Inside bias-cut section. One or two plies are laid back and the injury skived.

Ply Wrap and Boot Reinforcement

Made by cutting away a small part of the tread and breaker about three inches clear of the injury.

The side wall and bead cover is then removed. One ply is removed for one inch inside of the side wall and cut to toe of each bead. The injury is skived.

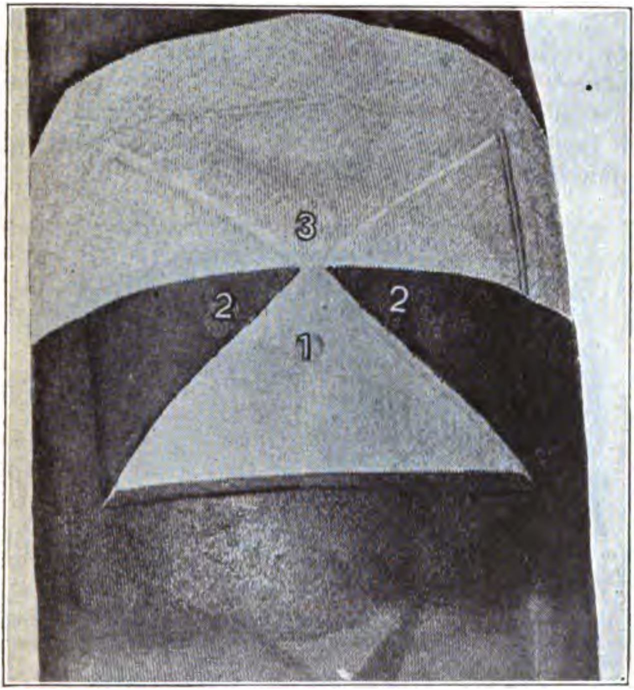


Figure 55.—Building bias-cut section. Replace fabric with fabric. Fabric blocks are applied and the laybacks brought down. Reinforced.

In building, the injury is filled with cushion and a ply of fabric cut to cover the repair, with a ply to go over the bead and double inside the tire. Cushion

is applied, including side walls and tread section. A boot reinforcement or bareback is applied inside the tire.

MOTORCYCLE TIRES

The regular three-inch motorcycle tire which fits the regular mould is usually repaired in the same manner as an ordinary three-inch tire. In many cases it is only necessary to remove one ply of fabric in light shell motorcycle tires. In heavier tires two plies should be removed.

Figure 56.—Ply wrap section. The ply of fabric extends across to both beads inside the tire and is covered with a reinforcement.

Two and one-half inch, or thin shell, tires of this type are usually repaired by cutting away the rubber around the injury for a tread repair, and a small inside section is stepped out on the inside of the tire in one inch steps and about one and one-half inches

from the injury. The tire is then buffed, cemented and allowed to dry.

In building, the tread patch is applied and the steps built up with fabric on the inside and with a reinforcement.

Should the tire then be too small, or not have the proper bead for the bead moulds, the tread repair can be cured on the tube plate, after which the inside section is cured by wrapping on the inside arm. The time of cure is slightly less than for the regular three-inch tire.

CHAPTER VII

CORD TIRE REPAIRS

CORD FABRIC TYPE

Tires of this type are popular, due to the demand for cord tires. They will be found everywhere, in many cases replacing the fabric tire. It is especially on buses, trucks and motor cars of heavy weight, that they are generally used as are also the cable cord types. The repairman must specialize on repairs to these tires and be able to deliver serviceable work.

In making repairs to the cord fabric tire the utmost care must be taken in inspection and in placing re-treads and sections to be sure that the plies of cord fabric are not loose or separated in the carcass of the tire. This trouble is likely to develop due to road pull or weave after long service. Dry cures in the mould are recommended in all cases for this type of cord, as wet steam in a kettle has a tendency to develop loose plies or to increase separation.

In entering the field of these repairs, new construction is found and a slight deviation is made in the repairing. The construction of this type of tire is somewhat similar to the fabric tire. It is built up in plies in the same manner, usually by hand, the thickness of the cord fabric depending on the manufacturer. There are approximately three different

weights encountered, a medium cord, medium heavy and heavy cord fabric. These different weights will therefore denote a greater or less number of plies in tires of the same size but of different makes.

Each manufacturer has a certain method of applying the cord fabric to the tire in relation to the run of the cords. Some change the direction of the cord alternately, while others will run two layers in the same direction and then reverse the cords. In heavy duty tires, some will be found to run three plies in the same direction. This should be noted on every tire when cut down. Expected changes in manufacture make it such that the exact running of the cords should not be too deeply impressed on the mind of the repairman.

Any cord fabric tires, from three-inch to the largest, can be successfully repaired with sectional repairs, tread patches, etc., when the tire has no loose plies and has not seen too much service. New tires with deep cuts or clean blow-outs are as easy to repair as a common fabric tire and the same operations are used. More care should be taken in stepping the plies and in pulling the cords when cut through. One ply at a time should be removed until able to allow plies to bunch and then remove them as on side wall steps.

GENERAL RULES FOR CUTTING DOWN

The same general rules would apply for cutting down these tires as for fabric tires and tires would be beyond repair for the same reasons. The buffing and cementing is handled in the same manner, but with more care as to buffing and roughing to prevent loosening or tearing the cords.

When reference is made to fabric operations, it is only necessary to refer to the steps explained under fabric tire repairs.

SCALE OF PLIES IN CORD FABRIC AND PLIES TO BE REMOVED

In sectional work from outside

Medium Cord Fabric

Size	Kind	Has No. Ply	Remove No. Ply	Measure for Splice
3½"	Regular	5 to 6	4	5"
4"	Regular	6	4	5"
4½"	Regular	7	5	6"
5"	Regular	7 to 8	6	7"
5½"	Regular	8	6	7"
6"	Bus	10	6 (1) inside	
7"	Heavy Duty	10	6 (1) inside	
8"	Heavy Duty	12	8 (1) inside	
9"	Heavy Duty	14	8 (1) inside	

Heavy Cord Fabric

Size	Has No. Ply	Remove No. Ply	Measure for Splice
4"	4	2	4"
4½	5	3	5"
5"	6	3	5"
5½"	6	4	6"
6"	6	4	6"
7"	8	6	8"
8"	10	7	9"

The above measurements on the medium weight cord fabric are stepped in three-quarter-inch steps, while the heavy type is stepped in one-inch steps, or similarly to fabric tires. Should one and one-half-inch steps be used on the heavy weight, as is sometimes done, it would only be necessary to allow one and one-half inches from the injury and add one and one-half inches for every step removed, plus the additional inch for the bead cover cut, and one-half inch for the splice cut.

Should the injury be through the tire, it is a simple matter to immediately arrive at the number of plies and step out accordingly.

In this type many airplane tires will be found, the sizes being few at this time, namely:

Size	Has No. Ply	Remove No. Ply	Measure for Splice Cut In 1" Steps
20"x4"	4	2	4"
26"x4"	4	2	4"
25"x5"	6	3	5"

ENDING OF PLIES AT BEAD

In cord fabric tires the workman should be prepared to find various endings of the plies at and around the bead. No set standard is available to go by for, in heavy duty tires, each size may have a different ending, not only in the next larger size but in the various makes. Experience and practice while cutting down will indicate the bead condition and this can be remembered for the build up. For a working example we will take the description of bead endings in a heavy duty size which is the most complex and which, when understood, will make small tire endings seem simple.

Size 38"x7"

Two bead covers are to be removed.

First ply on outside goes to toe of bead.

Second ply on outside goes to heel of bead, meeting inside ply coming over.

Third ply on outside goes to toe of bead.

Between the third and fourth ply an inside ply comes around and up the side wall to neck.

Fourth ply goes to heel of bead.

Fifth ply on outside goes to the toe of bead but is lapped by an inside ply coming over to the heel.

Other plies are past the anchor strip.

It is immediately seen that a standard for removing of plies to toe or heel cannot be followed.

In order to carry at least three plies to the toe of the bead on the build-up, it is necessary to cut at the toe the ply which is between plies one and three. This puts three plies on evenly.

In order to bring ply four down to the heel, it is necessary to cut the ply which lies between three and four at the heel.

When this is done, the outside build-up can be replaced evenly and will not necessitate a side wall cut until after five plies have been removed.

Should it be necessary to remove more than five plies, one or two plies can be ended on the side wall or cut from the inside of the tire.

In double Dunlop types the over-lay is encountered immediately after the two bead covers and two outside plies are removed. This makes it necessary to come up on the side wall at once. In this type, the inside section will be prominent.

In the heavy weight cord fabric, fewer plies are used and therefore the endings are usually replaced as removed.

The parts of the tire are exactly the same as in the fabric tire.

BUILDING UP CORD FABRIC TIRES

All operations in building up cord fabric tires are performed in the same manner as in the fabric tire, using either fabric or cord fabric for the rebuild. The

endings at the bead should be carefully noted when cutting down and the fabric replaced in the same manner. When cord fabric of the same weight as that in the tire is used, it is applied ply for ply. Should common fabric be used, usually two plies of fine cord fabric is covered with one of fabric, due to the thickness. In the heavier cord fabric the application is made ply for ply. It is best to use the cord fabric at all times in making the repair.

All cord fabric should be applied with the cords running in the same direction as the ply being replaced (not the ply underneath) and if two or three plies run in the same direction, the new fabric should be laid the same way.

REBUILD

Any Size Cord Fabric Tire

Made necessary on account of loose or separated fabric. Used when only one or two plies are loose on the top of the tire and which require retread, cushion, breaker and side walls. Cured in sectional moulds. A reliner might be inserted if properly cured.

It is seldom that the repairman will attempt a rebuild on this type of tire, due to the fact that the labor cost of repairs makes it impracticable. The ply, however, can be removed and new cord fabric of the same kind applied, with the cushion, breaker, new side wall, bead covers and band.

A complete new tire can be made, not only in small sizes but in heavy duty types, these being built up on the regular mandrel and cured in the sectional mould. The illustration shows a complete rebuild of

a 38"x7" heavy duty tire cut down. This tire, when put into service at a cost of fifty eight dollars, delivered over 8,000 miles on a two-ton truck and was in good condition at the time of writing.

Cutting and Building.—Rebuilding a cord fabric

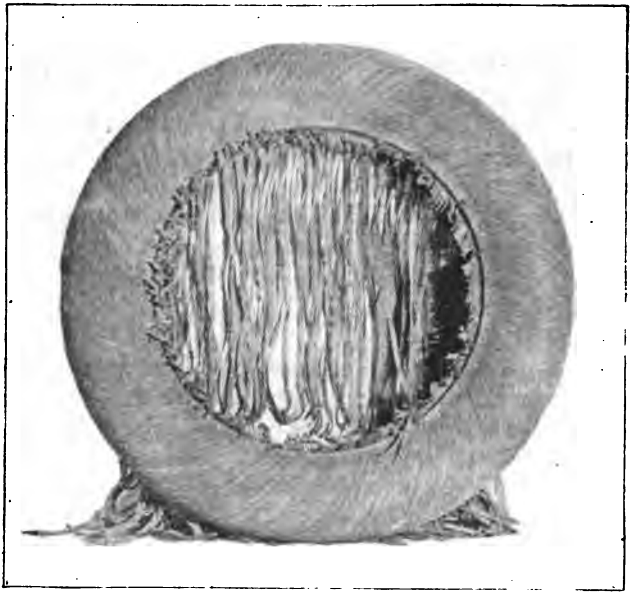


Figure 57.—Cutting down 38"x7" heavy duty tire.

tire is an expensive operation, although practical as far as the work is concerned. The operation would be identical with the common fabric tire, except that a heavy bead cover is used and a single side wall is added for the semi-cure. After this, a second side wall is applied, then the cushion, breaker and band.

The application of the second side wall keeps the first cure from getting brittle and, as a result, leaves a pliable side wall.

RETREAD

Any Size Cord Fabric Tire

Made with gum or a band to replace loose, worn, or badly cut treads. Used when no loose fabric is found in the tire after the tread is removed. Loose fabric is found by pressing the carcass in, when the loose spots will puff up, showing plainly. This should be followed with a long probe to find if a section will remove the injury. Dry cured in one-third sectional moulds for best results.

Cutting and Building.—Retreading of cord fabric tires is done in the same manner as that of the fabric tire, the retread band being used to the best advantage. In using the band, the tread is cut away one-half inch below the tread line. This allows for the use of the raw gum side strip in which to imbed the band sides when curing.

RECOVERING

Any Size Cord Fabric Tire

Includes the application of side walls, retread, and in some cases, new bead covers. A sectional cure is advised.

Cutting and Building.—Same as for fabric tires.

RECAPPING

Any Size Cord Fabric Tire

Used for replacement of narrow part of the tread or for use on a loose upper ply. Cured in the sectional mould.

Recapping of this tire can be done in the same manner as for fabric repairs. This method, however, should not be used as the band will be found more practical for service on a good tire with no loose fabric and with only a torn or worn tread to be removed.

Cutting and Building.—Same as for fabric tire.

Figure 58—Complete cord fabric section. Method of cutting and building on small four ply tire when only two plies are removed.

COMPLETE SECTION

Four-Inch Cord Fabric Tire

Used for all clean blow-outs, cuts, and jabs in both single or double lay-back. Used in some cases with an inside section to get at all plies in large tires. Recommended for casing breaks. Cured in the sectional vulcanizer.

Medium Heavy Class.—Recommended for all sectional work in place of three-quarter or side sections in order to allow the cord to cross the entire repair

to the beads, thus securing tensile strength. Because of no anchor thread, some recommend one to one and one-half-inch steps. This measurement can be

Figure 59.—Complete section on five inch tire cut for cord fabric build up.

Figure 60.—Complete section on five inch tire cut down for fabric build up.

used on small tires but must be reduced in large tires, due to size of the section.

Cutting Down

1. Locate the injury and measure five inches to cut splices on 45 degrees angle.

2. Open under the tread line to loosen the tread at side until it is free at the splice end.
3. Cut the tread back to same distance past the injury.
4. Block out first ply three and three-fourths inches from injury.
5. Block out second ply three inches from injury.
6. Block out third ply two and one-fourth inches from injury.
7. Block out fourth ply one and one-half inches from injury.
8. Cut side wall one-half inch from splice end and remove bead cover at this point on both sides.
9. Carry all steps down side wall, ending first, second and third at toe of bead. End last ply at heel, if possible. If Dunlop, one ply will end on side wall.
10. Skive the injury and all tread cuts.
11. Buff and wash, inside and out.
12. Cement.

In the heavy weight type, the operations are followed as given except as to measurements which are given and the steps increased to one inch. The bead endings are made as near fabric construction as possible.

Practice will enable the workman to increase the size of the steps should he so desire, however, this width in steps has been found to give good results and at the same time keep the section within bounds as to length for the mould and also strength in the tire.

Building Up

1. Fill hole with cushion.
2. Cut cord fabric of proper width and to lap the steps 1/16 inch. Apply as in fabric work, ending at the bead as taken out. The last ply is to come inside of the tire.
3. Apply heavy bead cover to replace the old bead cover and carry inside of tire under reinforcement.
4. Apply side walls.
5. Cover with cushion 1/16 inch thick and fill tread cuts with cushion gum in splice and wash.
6. Bring down tread and fit.
7. Apply double reinforcement same as in fabric work after filling hole.
8. Roll well, perforate and trim for cure.

Note: In using common fabric, build exactly as if using fabric tire covering with two plies of light cord fabric and using ply for ply of same thickness on heavy cord fabric. Fabric is not as pliable as the cord fabric which should be used if possible.

COMPLETE SECTION

Seven-Inch Heavy Duty Cord Fabric Tire Giant Pneumatics

Sectional repairs on this large size tire are being successfully made and, when properly made and cured, they will outwear the tire. Many manufacturers recommend a tread patch and large boot, which will protect the tube and also give good mileage. This method may be followed by the repairman until such time as he is capable of doing expert work, especially on small breaks.

In the repair of these large tires several methods are recommended by the manufacturers, depending greatly on the manner in which the cure is to be made. When only the air bag is used, a triple cure is recommended; that is, first curing the section then curing the tread section down under two cures. Should a special steam bag be used in connection with the cure, only one heat is necessary, although a higher steam line pressure is used in the bag. Some repair men make a cure in the mould under a single cure and then use the inside arm. However, the three cure method will be used by most shops because of the cost of using the steam bag and the difficulty of securing pressure on the arm.

Some repairmen do not step down the entire carcass of the tire to four remaining plies, but remove two to four outside plies and then cure. A large cord boot usually reinforces this type of repair.

Due to the stiffness of the beads in these tires, a heavy spreader is essential for inside work and for placing and removing the bags. Three hooks, for catching the bead on one side, are placed in the

floor and used in connection with a pulley for raising the other side when it is attached to similar hooks. This provides a simple spreading device in the absence of special spreaders.

The execution of an operation on a 38″x7″ tire requires skill, especially when attempting sectional work. Every detail of the trade is put into execu-

Figure 61.—Cutting down section on 38″x7″ tire. 1—tread section removed. 2—plies removed in steps. 3—cord boot used for reinforcement.

tion. More difficult operations than sectional work have been handled on heavy duty tires, namely, completely rebuilding and curing in a sectional vulcanizer, then putting into service to run double their mileage. The repairman requires only the confidence of his trade to successfully perform the work.

Cutting Down

1. Measure the length of the mould, which is usually thirty inches in a quarter circle seven-inch mould.

2. Remove the tread in a complete tread section two to three inches longer than the mould and at perfect slants.
3. Measure over 7″ from the end of the injury for first ply off.
4. Measure over 6″ from the end of the injury for second ply off.
5. Measure over 5″ from the end of the injury for third ply off.
6. Measure over 4″ from the end of the injury for fourth ply off.
7. Measure over 3″ from the end of the injury for fifth ply off.
8. Measure over 2″ from the end of the injury for sixth ply off.
9. Cut away the side wall two inches from the first block-out or ply.

Figure 62.—Building up section on 38″x7″ tire. Outer plies are built and boot inserted. Tread section applied.

10. Step out the two bead covers on both sides in this space.
11. Carry the first four plies down as far as bead construction will permit.
12. End last two plies (5-6) on the side wall.
13. Skive the injury and round the ends.
14. Jack the tire open and remove one ply from inside, slightly larger than the largest ply off on outside.
15. Scrape inside thoroughly and cement.
16. Buff outside thoroughly and cement.

17. Buff and rough, wash and cement the tread section.
18. Prepare a heavy cord boot for reinforcement when getting ready to build up.

Building Up

1. Fill injury with cushion.
2. Cut cord fabric and apply in steps, lapping 1/16 to ⅛ inch, and ending at bead in manner of removal. Last ply to go inside of tire.
3. Apply heavy bead cover and carry inside.
4. Apply side wall double.
5. Cover tread section cut out over job with cushion gum. Wash.

Figure 63.—Complete section ready for cure.

6. Do not apply tread until semi-cured.
7. Fill injury on inside with cushion.
8. Apply cover of cord fabric.
9. Apply heavy cord boot over all. Roll well.

Note: The section is now cured before applied to tread section.

10. Buff tread surface well. Cement three coats and let dry.
11. Cover with 1/16 cushion gum and double at splice. Wash.
12. Apply tread section and roll down well, trim and smooth. The repair is now ready for final cure.

The above repair is a practical long-lived job for large cord fabric tires which have large holes through

their carcass from jabs, and when cords are not loose throughout the tire. For a tire that has been in service a long time, the tread patch and large boot reinforcement will deliver considerable service and save the great amount of work in this repair.

Figure 64.—Giant pneumatic 40"x8" cord section. Cut down in same manner as 7" size with extra ply out. Tread section is removed for 34 inches to allow fit in mould. Nine and ten inch tires are repaired in the same manner when triple cure is made. A cord boot or reinforcement is always built in. Also shows proper method for tread patch or tread section repair.

THREE-QUARTER SECTION

Any Size Cord Fabric Tire

Used for the same purpose as the complete section for holes through the case and on the side of the tire.

Suitable for small size cord fabric tires, such as airplane and up to four inch. Cured on the sectional vulcanizer.

This repair is not recommended for use, but should be replaced by a complete sectional repair.

Cutting and Building.—Handled in the same manner as fabric work.

SIDE SECTION

Cord Fabric Tire

Cutting and Building.—Not recommended for use on cord fabric work, although in some small tires and airplane work it is employed. The operations are the same as for the side endings of the complete section and the same procedure as in fabric work is used in regard to the plies ending on top of the tire.

INSIDE SECTION

Any Size Cord Fabric Tire

Possible on small size tires and for use with the complete section to get at all plies. Made in the same manner as fabric inside section for holes through the casing. Cured in a sectional vulcanizer.

Cutting and Building.—Done in same manner as for fabric tires, allowing one and one-half inches to the steps if possible on tires up to 4½ or 5 inches. Can be built up with fabric or cord fabric.

The inside sectional repair would have to be made when using some types of equipment the same as for fabric inside sections, and with the tread patch repair on the outside of the injury.

REBUILT SIDE

Cord Fabric Tire

This repair is not advisable to any great extent on cord fabric tires, and in fact is never used. In some cases, a ply or two may be removed to eliminate a light rim cut all around on a tire in otherwise good condition. It would be repaired in the same manner as a fabric tire.

RECOVERED BEAD

Cord Fabric Tire

This repair, when necessary, is made like the fabric operation, using one or two bead covers. On heavy duty types, use double bead cover.

RERUN SIDEWALL

Cord Fabric Tire

The replacement of a side wall is made as in fabric operations.

BEAD SECTION

Cord Fabric Tire

This repair is usually made on clincher and false bead types when no cable is used. It affects only clincher and quick detachable tires. It is usually made at the same time as a sectional repair and cured in the sectional mould.

Cutting and Building.—Done in the same manner as for a fabric repair.

TREAD SECTION

Cord Fabric Tire

This repair is identical with the fabric tire repair.

TREAD PATCH AND BOOT REINFORCEMENT

Any Size Cord Fabric Tire

This repair is made in the same manner as a tread patch and reinforcement, except that a special boot

Figure 65.—Re-run side wall. Showing recommended method of slightly laying back the tread to allow new side wall stock to lap under. This eliminates feathering under heavy load while in use.

or patch reinforcement is used. Recommended by some for repairs to cord fabric in regular and heavy duty types. Cured in sectional mould.

This repair is used to some extent and is similar to the fabric operation. In heavy duty tires, it is used extensively by some workmen and has given good mileage. The procedure on large size tires is recommended by the manufacturers of some cord fabric tires.

Cutting Down

1. Trim off all loose rubber around the cut.
2. Buff and rough well.
3. Jack the tire open and scrap the inside thoroughly over a space larger than cord boot.
4. Wash well, inside and out, with high test gasoline.
5. Cement two coats.

Building Up

1. Cover the tread injury with cushion gum to regular cushion thickness and keep out air under or at the splice.
2. Build up tread patch with same color gum.
3. Fill injury on inside with cushion gum.
4. Apply ply or piece of cord fabric over injury.
5. Insert large special cord boot.
6. Roll and trim.

SIDE WALL PATCH

Cord Fabric Tire

Same as in fabric tire repairs.

TREAD PATCH

Cord Fabric Tire

Same as in fabric tire.

REINFORCEMENT

Cord Fabric Tire

Same as in fabric tire repairs, except that cord fabric is usually used in building.

RELINERS

Same method and use as in fabric tires. Used in most cases for emergency service.

CABLE CORD TIRE REPAIRS

In making cable cord repairs, a different method is used, due to the construction of the tire. In place of using a connected cord fabric, the individual unit of construction is a single cord of larger size and it is the replacement of this cord that requires explanation.

Cable cord tires will vary in the number of plies of cords used. Two, three and four plies will be encountered. If more are used it is only a question of a study of the cross section as to the best method of repair, once the other types are known.

The arrangement of these cords depends on the manufacturer. In the two ply they may run at right angles to each other. In the three ply cord, two may be at right angles with one ply running straight across the tire section. Four ply cords have each layer running at right angles to the one covering it.

Sectional repairs to cable cord tires are made according to the ending of the individual cords at the bead, which may be on either clincher, quick detachable or straight side tires. Clincher type tires, especially on airplane tires and in two ply construction, usually end both the inner and outer cords at the toe of the bead.

In the quick detachable types of all kinds in which a staple is employed to hold the cord, the cord loops around the staple at the bead. This staple is held in place by the use of bead covers binding a split bead core which locks the staple in place. When removing the cord it is necessary to remove the staple in order to loosen the cord. The staple is cut at the turn to allow for the replacement of a single cord. False

beads may be used on S. S. tires, making a Q. D. type in which the staple is not employed.

In straight side tires of early types, the individual cords, consisting of an inner and outer ply, ended at the toe of the bead and were held in place by bead covers. Cords of later manufacture, and made in larger capacities, have the inner cords coming over the bead toe and ending at the heel of the bead. The outer cords are carried over the heel and toe and come up the inside of the tire for about one inch. In this manner they lock both plies when the bead covers are applied.

In four ply cable cords, the two inner plies usually end at the toe of the bead where they are met by the two outer plies. Three ply cords have all three plies ending at the toe of the bead.

When cable cord tires were first used, very little attention was given to the repairman as to the proper repairs. Common fabric, in place of new cords, was used in an endeavor to repair blow-outs, etc. In many cases the cords were removed from the inside and then the outer cords removed by removing the tread and side walls. It has been found, however, that many of the cable cord tires can be repaired for both inner and outer cords from the inside, although it is necessary to make both inner and outer repairs on other types.

The following is a list of possible methods of making repairs affecting individual cords.

1. (a) Two ply cable cord tires, quick detachable (staple type) can be repaired from the inside without affecting the tread or splitting the bead.

(b) Or the inner ply may be removed separately, and the outer ply then removed by removing the tread and side wall. The bead must be split in this case.

2. (a) Two ply cable cord tires, straight side, with cords ending at the toe of the bead can be repaired from the inside without affecting the tread or side wall.

(b) Or the inner ply can be removed separately and the outer ply then removed by removing the tread and side wall.

3. Two ply cable cord tires, straight side with cords overlapping the bead, are repaired from the inside for the inner cords. The outer cords are repaired by removing the tread and side wall.

4. Two ply clincher type cable cords are repaired by removing the inner cords. The tread and sidewall are removed for the outer cords. It is possible to remove both from the inside.

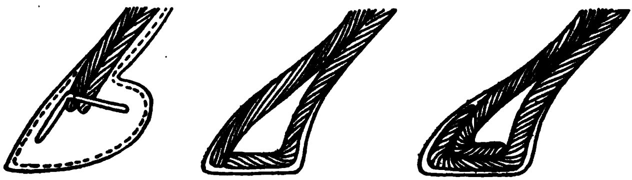


Figure 66.—Cord endings on cable cord tires, two ply tires shown. Four ply tires have cord ending at bead toe.

5. On three ply cable cords the outer plies are removed from the outside by removing the tread and side wall. After the cross cords on the inside have been removed for a sufficient space to clear, the inner cords can be removed.

6. Four ply cable cords are repaired from the inside for inner plies of cords and from the outside for outer plies of cords, as the two remaining plies are left and skived. It is necessary to remove the tread and side wall for outer plies.

The work of repairing cable cord tires is simple, requiring little material, but plenty of hard work. The same general rules apply for this work as in making fabric repairs. In buffing, the cords are roughed well and are kept perfectly dry and clean. Cement should be well brushed into the layers of cords and a thin coat should be used first in order to soak

in well. This is followed by two heavier coats allowed to dry well. The cable cord tire takes a retread in good shape and when cords are properly replaced, it leaves the tire with a solid foundation for unlimited mileage. All cords for inner or outer work are usually secured from old cable cord tires of the same size and capacity and are replaced in blocks of the same size as removed.

It is not advisable to use fabric in repairing these tires and if plenty of old cords are not available, they can be secured from the manufacturer whose material is used to the best advantage on the tire.

In locating the length of injured cords it should be remembered that the whole length to the ending at the bead of the next uninjured cord must be considered when only the inner cords are removed. When both plies are affected, consider the length of the outer run of the outer cord. The length of the outer cord can be determined by drawing a line at right angles to the inner cords and across the tire. This will designate the end of the section when allowance is made for the bead covers, etc.

Cushion gum 1/64 inch thick is used to the best advantage in this work when building up, even should it be necessary to double this gum on some tires. Too much cushion should not be used, only enough to flow evenly with top of cords. All cords should be exactly fitted when inserted and should fit in a manner to fill up the space.

REBUILD

Cable Cord Tires

This class of repair is not usually made in re-

placing a complete layer of cords. However, a considerable space can be repaired, a retread added, new side walls attached and bead covers placed. Staples also can be replaced in the Q. D. types, but this operation is rapidly being dispensed with. Cure in sectional vulcanizer.

RECOVERING

Cable Cord Tire

Consists of replacement of new side walls and tread, and in some cases, new bead covers are added. Cured in the sectional mould. The cutting and building is done in the same manner as for fabric tire repairs of this nature.

RETREADS

Cable Cord Tires

Made from gum, or, more practically, from a retread band. Used for loose tread, and worn, badly cut or torn treads. Cured in the sectional vulcanizer or kettle as this tire takes a kettle cure fairly well. The wet steam does not affect the carcass as in other tires. Follow instructions under *Fabric Retread.*

INNER CORD SECTION

Two-Ply Cable Cord

This operation replaces worn or broken cords on the inside of all types of cable cord tires. Cured in the sectional mould.

Cutting Down

The following operations cover the staple type. Clincher or S. S. types are handled in the same manner when inner cords alone are affected.

1. Partially turn the tire and locate the broken cords. Mark the ending of the inner cords at the bead on both sides.

2. Pull the broken cords across to both beads, which will show the space at bead requiring bead cover removal.
3. Cut through both bead covers about two inches on each side of the damaged cords and lay back or remove entirely around the bead.
4. Staples holding the inner cords are now exposed for removal.
5. Cut the first remaining undamaged cord at the staple, turn on each side and pull out the damaged cords entirely.

Figure 67.—Inner cord section cut down.

6. Select new cords of the same size and type and fit to the repair, taking care to insert to fit the staple. Turn as cut out.
7. Buff well and rough both the section and the new block of cords.
8. Wash with high grade gasoline.
9. Cement two or three coats as shown before.

Building Up

1. Cover the space of the removed cords with 1/64″ cushion gum, lapping slightly over the sides and out to the staple turn.
2. Fit the new cemented cords and stitch down well, seeing that the cut cord is fitted as taken out at the staple turn.
3. If a Q. D. with staples, place the staples by forcing them in place with pliers and, if necessary, use an awl to open up the staple hole.
4. Cover the entire repair with a layer of 1/64″ cushion gum the toe of beads.
5. If new bead covers are required, use two plies. The first ply is to fit from the toe of the bead up one inch on

Figure 68.—Building outer cord section, clincher type. 1—One sixty-fourth inch cushion applied. 2, 3—cord fabrics fitted. 4—cord fabric to cover. 6—cushion placed. 7—bead cover.

the cords above the staples on the inside. The second ply should come up 1½ inches on the cords on the inside.

6. Roll well before set-up for cure.

OUTER CORD SECTION

Two-Ply Cable Cord (Staple Type) Q. D.

The inside method of repair is used for replacing outer cords from the inside without affecting the tread. Cured in the sectional mould.

Cutting Down

1. Locate the broken outer cord and mark the bead covers two inches past end of outer cord to be removed.
2. Lay back or entirely remove the bead cover on both sides of tire, exposing all staples in the section.
3. Pull all staples on both sides for the entire length of the section.
4. Split one inner cord at staple turn and lay back inner cords both ways until the outer broken cords are exposed.
5. Split the outer cord at end of damaged cords on both sides and pull damaged outer cord out entirely.
6. Select new outer cords of same size, make and fit.
7. Buff and rough section and new cords.
8. Wash with high test gasoline.
9. Cement two to three coats and allow to dry.

Building Up

1. Lay in a layer of 1/64" cushion gum to lap the remaining cords.
2. Fit the new cemented outer cords and stitch down well with staple turn, fitted exactly.
3. Place a layer of 1/64" cushion gum between the inner and outer plies.
4. Bring down the inner cords, which have been laid back, fitting them at the staple holes and placing staples as brought down, if in a staple tire.
5. Cover the complete section with 1/64" cushion gum.
6. If required, apply bead covers in the same manner as for inner cord section.

Note: The first bead cover, when carried around the bead, is made of a cord fabric which runs from above the outside bead channel around inside the tire and up about one inch on the cords. The heavy bead cover of fabric starts slightly under the first on the outside and laps over on the inside.

7. Roll well and set up for cure.

OUTER CORD SECTION

Two-Ply Cable Cord (S. S. Type)

With cords ending at toe, this repair is made in the same manner as the staple types, except that the outer cords are pulled through the side wall after the side wall has been buffed away. Replacement is made in the same way, and the side wall is added.

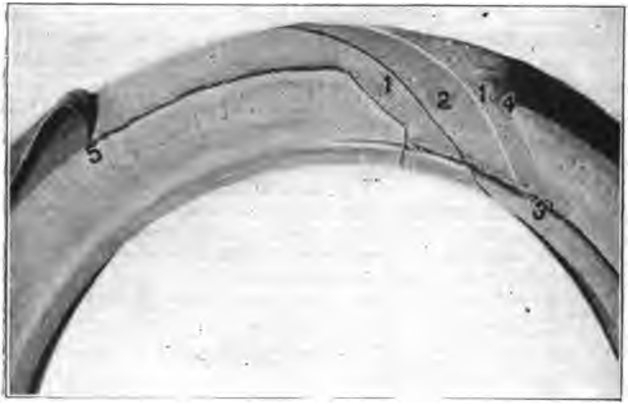


Figure 69.—Outer cord section, clincher type.

Figure 70.—Outer cord section, SS C type. 1—one sixty-fourth inch cushion applied. 2—cords fitted. 3—cushion cover. 4—bead cover, heavy. 5—side wall.

OUTER CORD SECTION

Two-Ply Cable Cord (S. S. Type)

With cords lapping the bead, this method is used for replacing broken or worn cords from the outside of the tire. It is used on clincher types, and on outer ply for four-ply cable cords. It is either lapped or bound over the bead, or the cord plies interfere with making the repair from the inside. The inner cords, however, are repaired from the inside as shown before. Cured in sectional mould.

Cutting Down

The inner cord section is made as shown before, except that the outer cords are pressed back. The outer cords, however, are best removed from the outside. This makes it unnecessary to loosen all outer cords, which would have to be done if attempted from the inside.

1. Cut a splice through the center of the proposed section, usually through the break, as a double layback is practicable.
2. Lay the tread back on both sides to clear the space required for pulling the outer cords.
3. Cut out the side wall about one to two inches on a slant to clear the damaged cords.
4. Pull the damaged cords down to the bead and cut away the bead covers two inches each side of the loose cords around the bead and inside.
5. Remove the loose cords which run over the bead and inside the tire.
6. Select new cords of same type, size, make and fit.
7. Buff and rough the new cords, the section and tread splice.
8. Wash with high test gasoline.
9. Cement two to three coats and let dry.

Building Up

1. Apply a layer of 1/64″ cushion gum and stitch down well.
2. Apply cords, fitting them from toe to toe and rolling.
3. Apply bead covers.
4. Apply side wall strips and tread, or bring down layback if used.
5. Perforate and roll well.

OUTER CORD SECTION

Four-Ply Cable Cord

This repair affects only the single outer ply of cords. The remaining plies are allowed to remain and are skived or feather edged around any hole. Cured in the sectional mould.

Cutting Down

1. Lay back or cut the tread away for about two inches each way from the injured cords.

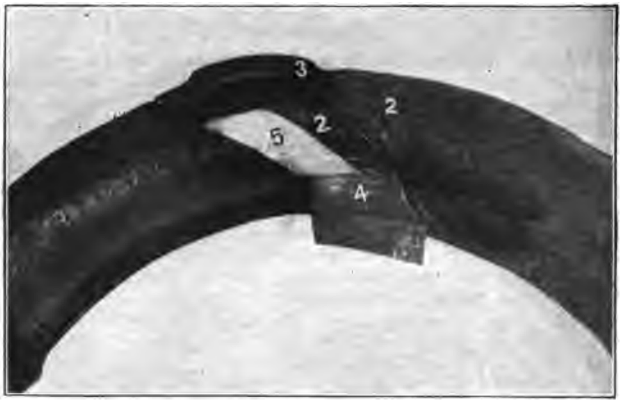


Figure 71.—Building outer cord section, clincher type, with cable cord. 1—one sixty-fourth inch cushion applied. 2—cushion placed. 3—cords fitted. 4—bead cover. 5—side wall.

2. Cut away the side walls.
3. Cut away the bead covers on both sides for two inches to clear the cords to be removed.
4. Pull away the injured cords.
5. Select new cords to fit, buff and cement.

Building Up

1. Apply a layer of 1/64″ cushion gum to lap over the remaining cords.
2. Insert the new cords and stitch down well.

3. Apply layer of 1/64" cushion gum over the new and old cords. Apply bead covers.
4. Cover tread surface with cushion gum 1/32" thick and lap on splice.
5. Apply side wall of same color as tire.
6. Cover beneath tread injury with cushion.
7. Bring down tread and fit well at the splice. Fill tread injury with tread gum of same color.
8. Roll and trim for cure.

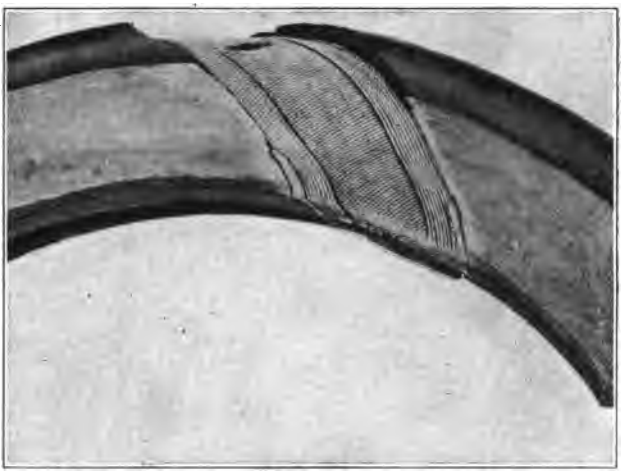


Figure 72.—Outer cord section, four ply heavy duty. The outer ply is removed, one inner ply removed and the injury skived. Built with cords or fabric.

Note: In the repair of this type of cord, some repairmen use cord fabric in place of cords. The cord fabric is cut straight in a width to fit into the cavity caused by pulling cords. Sufficient plies are placed to fill up evenly with the top of cords and a cover ply is laid to lap about one to two inches over all.

Airplane Tires.—The outer cord section on clincher type airplane tires is handled as just described. Should the inner cords be affected, an inner cord section is used in connection with the outer repair.

INNER AND OUTER CORD SECTIONS

The inner and outer cord section is a combination of inside and outside repairs as described before. In

Figure 73.—Inner and outer cord section for quick detachable or straight side two ply type. 1—bead covers laid back. 2—staples removed. 3—inner ply laid back. 4—outer ply cords. 5—broken cords removed.

making an outer cord repair from the inside, the inner cords are always affected. Otherwise the work is merely two operations combined.

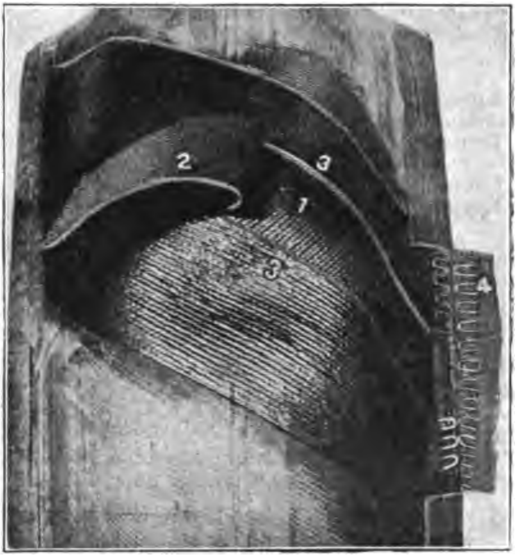


Figure 74.—Inner cord separation. 1—cushion applied. 2—loose cords laid back. 3—cushion cover. 4—new staples placed and bead cover.

CORD SEPARATION

Cable Cord Tire

This repair is made, in both S. S. and Q. D. types, from the inside for loose cords caused by under-inflation or bruises. Cured in the sectional vulcanizer.

Cutting Down

1. Locate the loose or separated cords and mark bead covers.

2. Cut away or lay back the bead covers two inches each way on one end of the cords.
3. Pull staples, if any, and cut cord at staple turn.
4. Lay the cords back loose to allow for buffing.
5. Buff and rough well.
6. Wash with high test gasoline.
7. Cement two to three coats and let dry.

Building Up

1. Apply cushion gum 1/64" inch thick, over and lapping the remaining cords.
2. Bring the cord ends down and insert staples in Q. D. staple tires.
3. Cover complete repair with 1/64" cushion gum.
4. Replace old bead covers or add new ones.

RECOVERED BEAD

Cable Cord Tire

New bead or bead cover same as for fabric. Replaced as taken off.

Cutting Down.—Removed as on fabric work.

Building Up.—Same as fabric, except that one ply of cord fabric is first applied one-half inch above the channel and around inside the tire if removed. The second ply, bead cover, starts below the first and is carried to the toe, or inside if removed.

RERUN SIDE WALL

Cable Cord Tire

Replacing new side walls is performed similarly to fabric work. Cutting and building operations are the same as in fabric repairs.

BEAD SECTION

Cable Cord Tire

For replacement of broken bead in Q. D. staple types. Cured in sectional mould.

Cutting Down

1. Trim off the side wall for one and one-half inches up the wall.
2. Cut away the old bead covers completely around the broken bead, allowing two inches past required bead section.
3. Pull staples on the inside if necessary to replace any.
4. Cut through the bead at the heel on both ends of the injured bead section.
5. Split the bead halfway between the heel and toe through the length of piece to be removed.

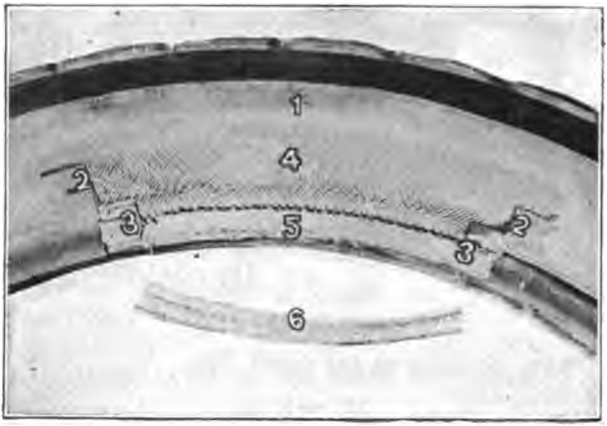


Figure 75.—Cutting new bead section. 1—side wall. 2—bead covers. 3—bead. 4—split bead removed. 5—staples.

6. Select a new piece of bead of the same length and fit.
7. Buff and rough well.
8. Wash with gasoline.
9. Cement two or three coats and let dry.

Building Up

1. Cover the cords with 1/64″ cushion gum.
2. Cover ends of bead section with cushion gum and fit the bead section in place.
3. Stitch the new bead section well into place to form the bead channel.

4. Apply new cord fabric bead cover to come up one-half inch above the channel of bead and down to toe, or inside if removed.
5. Apply heavy fabric bead cover, starting slightly under the first above the bead channel and carry down to toe, or inside if removed.
6. Replace side wall with same color gum and trim.

Figure 76.—New bead section placed, bead cover and side wall added.

TREAD SECTION

Cable Cord Tire

Same operation as for fabric tires.

TREAD PATCH

Cable Cord Tire

Same operation as for fabric tire.

SIDE WALL PATCH

Same operation as for fabric tire.

LINING PATCH

Similar to the fabric reinforcement, but not used to any great extent, as the cords alone, when properly replaced, have sufficient tensile strength to carry the outside repair.

Cutting Down

This repair is similar to the reinforcement in a fabric tire. Can be reinforced by using cord fabric, but is not used to any extent.

Building Up

1. Cover with two blocks of cord fabric.
2. Stitch well and cure.

PUNCTURE PATCH

A reinforcement over a small nail hole in which the cords are not injured, but which might injure the tube. A single cord cut by a nail can be tapered, and a short piece of cord placed with this reinforcement, covering the break and giving good results.

Building Up

1. Fill small hole with cushion gum.
2. If necessary, cover with small block of cord fabric and cure.

REPLACING STAPLES

Cable Cord Tires, All Types

This repair is not used extensively. It is a long job and usually requires replacement on both sides if either. If within the mileage guarantee it can be adjusted.

Cutting Down

1. Lay back the bead covers to save them if possible.
2. Pull all exposed staples.
3. Buff well, wash and cement.

Building Up

1. Insert new staples by pressing them in place with pliers or by using a large awl to open hole.
2. Apply layer of 1/64" cushion gum over the staple surface.
3. Bring down the old bead covers and stitch in place or add new ones.
4. Cure.

CHAPTER VIII

STEAM AND CURING

All preceding work has been that of preparing the tire for vulcanization or curing of the raw gums placed in the repair to form a solid unit for appearance, shape, and strength. A good steam-man can, in many cases, make a good looking repair out of a poor build-up. However, in order to have strength and deliver service, the preparatory work must be done properly. On the other hand, the steam-man can spoil good work through carelessness or ignorance of his plant or steam requirements. The steam-man must be capable of handling the plant to the extent of setting it up and locating any difficulties in securing proper heat and circulation. He must also know the stocks used in the repair and the time required to properly cure or vulcanize them to a satisfactory degree.

The success of vulcanization is in properly compounded rubber, formed to a required shape, and placed in a container of the same shape. Then, under correct pressure, a certain heat is applied for a specific period of time, which flows and sets the rubber. The desired condition, or cure, of the article or the repair is secured either by the extent of the time of cure, by the degree of temperature, or by the use of hastening compounds in the rubber.

It is necessary to first become acquainted with the stock so that the heat unit or time of cure may be derived from the tables or by rubber tests to determine when the point of proper cure has been obtained. The testing of cured repairs is a simple matter for the vulcanizer, as an approximate time table is always available and the slight variation in temperature between plants is easily noted.

Every repair should be tested or inspected, as a stoppage of the steam circulation may occur at any time or the temperature may drop from many other causes, such as pocketing of water or air, forgetting to open valves fully, or blocked pipe connections or valves.

Pushing a pencil into the cured gum is a good method of test. If an undercure is apparent, the gum will be found soft and the indenture will remain in the gum. Overcures are brittle and hard. A perfect cure should be solid, but still have life and resiliency and come back into place immediately when pressure from a pointed object is applied and removed.

Gums can be tested for time of cure on a flat plate by using a piece of the gum, say one inch wide and four inches long, and giving it an experimental cure under flat pressure. Then cut the piece lengthwise in the center for two inches and pull on one side. An undercure will show an elongation of that side, which, when released, will be longer than the other. If properly cured, it will come back into place readily, still having the resiliency and elasticity required, but remaining solid. An overcure will be brittle and will break or tear easily.

In the vulcanization of tires, two kinds of heat are

encountered. Dry heat, applied through moulds, plates, arms or special steam bags and tubes which takes a longer cure than the kettle. Wet steam heat is used when curing in the kettle or open pot. The heat is increased above the boiling point of 212 degrees, to a higher temperature and pressure for curing the rubber, and it is known as a high-pressure steam. This steam can be generated at pressures higher than required and then be reduced in non-return systems to the required pressure and temperature for use in the individual mould, kettle, or otherwise. Small plants using gas burners or coil boilers of the straight gravity type have a heat which carries no regulation outside that of regulating the flame, and which requires more attention. However, gravity systems can be accurately regulated through the flame.

The matter of various kinds of equipment is fully covered under the head of "*Equipment.*" There are many important matters that come up daily and that should be remembered by the repairman in the care of his plant.

The boiler, if of the larger type, should be blown off at least weekly to carry away all sediment. This is done by having the water line even and allowing the steam to drop gradually to about 10 or 15 pounds pressure, then opening the boiler drain. The drain should be closed to leave a little water in the boiler. This will increase the efficiency of the plant and the life of the boiler. The flues should be cleaned regularly at least once a month, as this will decrease fuel costs, especialy if coal is used. If using gas, the flues should be cleaned about every three months.

In setting the piping and drainage, the pipes should

be large, with all pipe ends reamed after cutting, to allow for complete circulation. On large boilers, one and one-half to two-inch pipe should be used from the boiler as a main line. Three-fourth-inch or one-inch pipes can be dropped to the moulds, and the mould outlet can be one-half to three-quarter inch. All connections to the main line should come out of the top of the feed and drop over to the mould or plate. The lines as well as the moulds, can be covered with asbestos to prevent condensation and save fuel.

METHOD OF OPERATING STEAM GENERATORS

Gas Burner.—In this type it is only necessary to fill the boiler or mould water container so that the water line is above the center of the glass. Light the gas burners and allow the steam to come up to the required pressure. If no gas controller is used, the valves are adjusted to keep the pressure up. On large plants, the main steam line valve is closed until the steam is raised to approximately 75 or 80 pounds. The valve is then opened slowly to allow the steam to pass through the moulds.

On coil boiler, gravity return types, both the main and return steam valves are closed until steam is up. They are then opened, first to the feed steam lines, then to each individual mould.

Gasoline Burner.—This type is used on coil boilers and individual moulds, being fed from gravity gasoline tanks or by force feed systems. The valve or valves to the burners are hand regulated and the steam lines are operated in the same manner as with the gas burner type.

Coal Boilers.—Coal boilers are usually of the large type, being used the same as large gas boilers. The pressure fluctuates considerably and better results are secured by keeping the steam up to 75 or 80 pounds and reducing to the required pressure through a pressure regulating valve to a non-return system with a trap or pet-cock for outlet of the condensation. The main steam line is kept closed until steam is up and is then opened slowly until the full pressure required is going through the regulating valve.

To allow for thorough heating, each mould should be blown off every morning after turning the steam on and occasionally during the day. This keeps the cavities open. Pet-cocks placed on all moulds or plates near the top and also at the bottom, will give perfect control of the mould, and allow for escape of either air or water.

Pressure gauges should be where readily seen, both on the boiler and at the moulds, with a thermometer (Fahrenheit) as a check for actual temperature. The temperature will vary with the gauges, which in many cases are not correct. It is sometimes necessary to increase the pressure to secure the heat.

A water glass placed below the drain line of the moulds will be found useful, especially with a steam trap, to show if the line is clear of water. In place of the trap on non-return systems, pet-cocks can be used and drained into the sewer or tank. These will keep the line open.

The moulds, plates and bead moulds should be cleaned daily from soapstone, rubber, etc., by using fine emery paper. It is not practical to use coarse brushes on this work, as they will scratch and mar

the moulds in time because of the wires following a line when started.

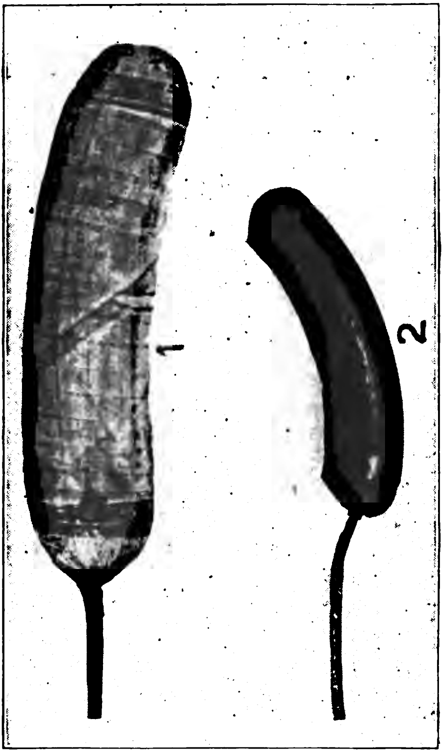


Figure 77.—Air bags. 1—seven inch bag. 2—regular bag.

Keep all valves or pet-cocks working easily. When opening the valves have them fully open, or fully closed when not using.

AIR BAGS

Air bags are supplied in various lengths and sizes to meet the needs of the repairman. In all cases the manufacturer will state whether or not water should be placed in the bag. The manufacturer's decision should be followed in this matter, as he is in a position to know the compounds used in the rubber when making the bag and if it will, or will not, stand water for best service.

Two shapes are made, both of which can be used in either S. S. or Q. D. tires. If possible, after once being shaped to either the Q. D. or the S. S. tire, the bag should be used only in that type. The Q. D. bag is practically round, while the S. S. has sloping sides and a straight base. Padding can be used in many cases, which will take up the space.

The purpose of the air bag is to supply expanding pressure against the inside of the tire when in the mould. This forces the heated and flowing gum into a solid unit, where it sets. The bag is made to stand pressure under heat, but not any great amount of expansion. When the bag is too small for a tire, it must be padded in order to deliver pressure to the repair and at the same time protect the bag.

Immediately upon receiving new bags, they should be inflated and tested for leakage. This should also be done at intervals during use, which will stop many bad cures. Gauge tests can be made during the curing of a tire to see if the pressure is kept up on bags that have been in service for some time. It should be remembered that the application of the air gauge to the valves will drop the pressure considerably each

time applied, this being due to the small air capacity of the bag. Tape should be wrapped around the hose to increase its strength and life when in use.

In selecting a bag for use in the mould, it should be shorter than the mould in order to stop riding at the end. Some bags force the tire against the edge of the mould, and when the clamp pressure is applied, an unsightly ridge is left in the casing. The long bag can be used when special flanges or shields or heavy impression pads are used.

The air bag, when inflated and heated, will increase in pressure, due to expansion of moisture in the air or bag. This expansion has been found to be approximately twenty per cent under actual tests. Hence it is only necessary to place fifty pounds of air in the bag to secure sixty pounds pressure when heated. The average inflation of tires will depend on the thickness of the carcass, which acts as a resistant as more plies are added. The following table has been found dependable for all sectional work:

2½	to 4½	inch tires	—50 pounds
5	to 5½	inch tires	—60 pounds
6	to 8	inch tires	—70 to 90 pounds

When applying the bag in the tire, the bag, the interior of the repair and any pads should be dusted with soapstone to prevent sticking. The bag should never be set in the mould to warm up, like the impression pad, as this will harden and injure the bag in time. See that the bag fits snugly with bead moulds set properly. Aim to keep the interior capacity filled up by padding as much as the bead moulds will allow. This will prevent decreasing the

capacity of the tire at the repair point, which would later expand under inflation, throwing a strain on the rubber, which deteriorates when stretched and kept so.

When the cure has been completed, air should be released from the bag before loosening the clamp, and the bag slightly inflated when removed from the case.

Air bags should never be used for building forms or be allowed to lie around on the bench or on the floor. Make a small wire loop close to the bag on the hose and hang up when not in use.

Bags should never be pulled from the tire by the hose, but, when sticking slightly, should be slowly worked loose by the other end. The best way is to press the tire on the flat bench or on the floor, which will allow the bag to force itself out by spreading the beads. Air bags that are used properly should handle from one hundred cures up, and some run as high as three hundred cures. When less than seventy-five cures are obtained, abuse of the bag is apparent or poor bags are being used.

Leaks in air bags can be temporarily stopped by introducing a little water with flax seed or corn meal, or by mixing three parts of vulcanizing cement with one part of soapstone to make one-half glass or more, according to the size. This combination is mixed thoroughly, injected into the bag and shaken around.

On some equipment the rubber block is used to replace the air bag, the pressure being applied to the block by use of hand clamps. By shifting the block for direct downward pressure, cures can be made to cover the whole section. This method, however, is more practical for tread repairs, the air bag giving the best results for complete section work.

Another system to replace the sectional repair is to make an inside section and surface tread repair. The cure is then made on the inside arm, with a patch vul-

Figure 78.—Filling pads. 1—airplane. 2—bead pad. 3—regular.

canizer placed outside to cure the tread patch. With this method the air bag is not used.

PADS AND FACE CLOTHS

Padding of air bags increases the life of the bag,

gives better pressure to a repair and does not allow the bag to stretch. The exacting steam-man will see that the pad is properly placed and that the bag fits snugly. The best procedure is to insert the bag and note how much padding is required by pressing the beads together, which in clincher and Q. D. types come closer than in the S. S. type. Improper padding will result in weak repairs and buckles that are likely to develop from the clamp pressure.

All padding is made from the carcass of old tires. Pads are made in one, two or three plies and about three inches longer than the bag in use. They are stepped down on the inside in one-half-inch steps so not to crease or spread the beads apart at the base. When the bags do not come high enough at the beads for pressure, inner tubing can be cut in strips ranging from one and one-fourth to three inches wide and laid in the center of the pad. This should raise the bag properly, but if it fails to do so, a bead pad made from an old flap can be inserted.

Airplane tires are cured in the regular cavity. Special pads are used which do not stretch the bag out of shape, because of the small arc and thin shell construction. These also to give perfect pressure. The ordinary two to three-ply type is built up in the center with about four plies of fabric in steps covering four inches of the widest ply. A bead pad is then made from a flap. It should be heavy at both ends and thin in the center. The greatest care must be taken when applying the bead moulds that the beads fit the bead mould channel when forced down on the small circle.

Heat pads, or heat cloths as they are sometimes

called, are used on every repair. They stop burning, keep gum from the mould, and also hold soapstone on non-skid tires when saving the design in this way. All cloths are applied wet.

Cloth is also used for tearing into strips and small squares are used to cover all raw gum before applying the long cloth or for building or padding a low place for pressure. Cloth can also be rolled up and laid in N. S. indentures to apply pressure. It is also used in strips about four inches wide for wrapping tires during kettle cure.

SOAPSTONE AND ITS USES

Soapstone (not talc or mica) is used extensively as a lubricant in vulcanizing rubber. It prevents sticking to metal or between fabrics. It should be tied in a muslin bag and dusted on all new gum, inside and outside a repair, on the bead moulds, and in the moulds when making a cure. When it is desired to save the non-skid impression already made on a tire, water is mixed with soapstone until a thick paste is formed. This paste is applied in the crevices and covered with a heat cloth. Soapstone itself does not act as a pressure-giving substance and should not be used against raw gum.

By mixing soapstone or talc with light brown cement, an inside paint can be made that will keep the tube from sticking. It can be thinned with gasoline, which will evaporate, leaving the soapstone adhering to the case interior. Dry soapstone can be laid in the moulds. Plaster of Paris on particular work makes a perfect cure.

IMPRESSION PADS

Impression pads are used for retaining the non-skid design or for adding a new non-skid on raw gum in sectional work. This forms a practical way of securing good pressure on the repair at all points and down into the indentures. The pads can be

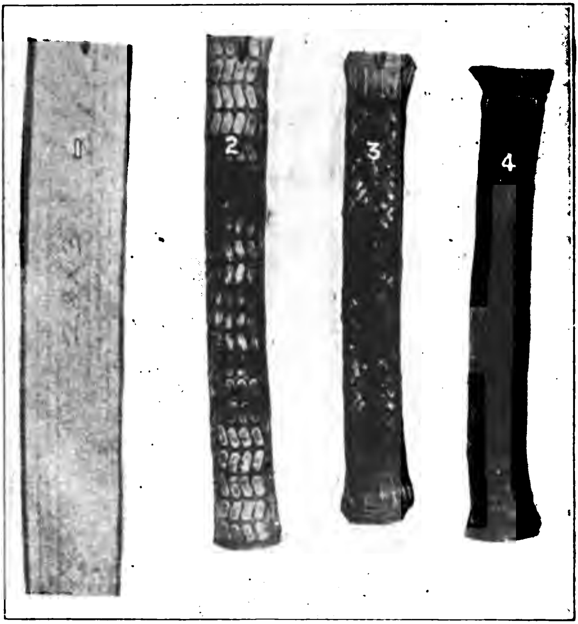


Figure 79.—Impression pads. 1—uncured pad. 2, 3, 4—cured pad.

made as non-skid, ribbed, or plain, being for use only on the same kind of print after once made. When applying impression pads, great care is to be taken

in fitting them properly to old non-skids and in matching, also for centering on the tire. They may be tied on at each end to stop stepping and to hold them in place, especially on new gum, or patching cement can be brushed over the pad and on the tire tread and the pad stuck exactly where needed. The patching cement will soften and loosen up under heat, allowing the pad to come away easily after the cure. However, patching cement should not be brushed on new gum.

The following instructions cover the making of pads for one-fifth circle 26-inch, also one-fourth circle 30-inch moulds. In making pads, two plies of fabric or bareback are cut the necessary width for the tire. This is about one inch wider than the tread design to be made or saved, with the inside ply one-half inch wider on each side than the outer and to clear bead mould. Between these two plies of fabric are laid from two to three layers of tread gum, depending on the thickness of the design. This is placed in steps inside the narrow strip of fabric. All is hand rolled for uniting. The pad is then laid in the mould to warm up, then, after soapstoning, is tied or cemented with patching cement on the tire from which an imprint is to be made. The whole is then placed in the mould and cured for about forty minutes, and when removed gives an exact negative of the print desired.

Some make pads from one ply of fabric and apply the tread gum. This will, in time, crack and chip away; however, in following the foregoing method, a strong non-chipable pad is secured that will stand double the use and abuse.

Pads used for some time will become hard and

brittle when cold. They should be placed in the mould for a short time to warm, when they will roll or bend easily and can be fitted snugly by first securing one end, then following it up by watching underneath as applied along the entire section. Impression pads will run one hundred cures or better. Ten to fifteen minutes is added to the cure when a pad is used.

GENERAL INFORMATION ON CURING

1. Always have complete circulation of live steam in the line and moulds.

2. Even pressure must be had at all times on repairs.

3. Heat does the curing, not the pressure on the gauges.

4. Repairs on casings larger than four-inch should be cured on the arm after coming out of the mould.

5. Marking or tearing away of the side wall may be due to dirty moulds. On old tires, use patching cement and dust with soapstone.

6. Paraffine and a small quantity of graphite rubbed on the moulds with emery paper will prevent sticking and keep them smooth for several days. No soapstone need then be used. Cocoa butter can also be used.

7. Castile soap applied to the mould in a lather while the mould is hot makes a good non-adhesive. It must be repeated every few days.

8. As soon as the repair has been cooled, all surplus gum should be rasped or ground off to give a smooth appearance.

9. Put all cured repairs into service at once to secure the best results. The repair gum deteriorates quicker than that used in new tires.

10. Porous spots indicate insufficient pressure.

11. Blistering or blows are due to moisture or dirty inside spots. A drop of wet cement will cause a large blow. When a blow occurs, immerse in water at once to reduce the steam that is formed.

12. Ridging is caused by using a bag as long or longer than the mould.

13. Buckling of the side wall is due to improper padding

and to too great clamp pressure. The clamp should always be released slightly to fill out the bag.

14. Blow out the steam lines occasionally to stop erratic cures and to have complete circulation.

15. Clean the mould, bead moulds, and plate every morning before turning on the steam.

16. Have pet-cocks on every mould, plate, or arm, to drain the water and blow off air.

17. Always have a thermometer on the plant. Feel the heat in moulds by wetting tips of fingers and touching. If the moisture sizzles white and disappears at once, the temperature is up.

18. Use a bead spacer in carrying the undersize bead mould up to the oversize mould when curing the straight oversize tire.

19. To secure pressure on low spots, fill with a wet cloth, flat or rolled.

20. Wood forms, cut to fit smoothly to the ends of the moulds, will stop ridging or marking, also blistering of tires, on one-third circle moulds. They can be used to advantage.

CURING TABLES

The time of cure for different repairs will depend on the steam pressure used. This pressure may be forty, fifty, fifty-five, or in some cases, sixty pounds, depending on the plant used and in some cases on the materials in use. It has been found that all stock will work well at fifty to fifty-five pounds. Tests should be made when operating a new plant to see that the time is correct and the tables used accordingly.

Temperature being the degree of heat contained in steam, and pressure the force which is derived from the expansion, it can be seen that a long run of pipe will have a heat loss greater than the pressure loss, so that the plant conditions must be considered. The thermometer will indicate the exact heat when placed

on the mould line and when checked against the pressure gauge should show the following:

STEAM PRESSURE	DEGREE OF HEAT, FAHRENHEIT
35 pounds	280.6
40 pounds	286.7
45 pounds	292.4
50 pounds	298.7
55 pounds	302.6
60 pounds	307.3
65 pounds	311.8

It is readily seen that the time of cure will fluctuate with the difference in heat. It has been found that a change of ten pounds in steam pressure will require a change of approximately ten minutes in time. Therefore, with the following tables, it will only be necessary to add ten minutes when curing at forty pounds pressure and deduct ten minutes when curing at sixty pounds. Should a tire be thick, a slightly longer cure should be used.

The cure should be made completely through the tire, as fabric on the inside not properly cured will shift when inflated and cause a hump in the repair. In a short time this will blow or cause further breaks in the repair. A test for complete cure is to rub a few drops of gasoline on the inside reinforcement and if not thoroughly cured the cement or friction stock will rub away.

When deciding on the proportions between time and temperature, should considerable latitude be allowed in the choice, many operators prefer to use a comparatively low temperature and extend the time for the cure on the theory that the finished work will show better resiliency and wear.

TABLE FOR SECTIONAL REPAIRS AT FIFTY POUNDS PRESSURE

(The time of cure should be arranged to suit the heat in use)

Size	*Fabric Tires*	*Cord Fabric Tires*	*Cable Cord Tires, 2 Ply*	*Cable Cords 4 Ply*	*Airplane Thin Shell*
3 inch	45 min.	50 min.			40 min.
3½ inch	50 min.	60 min.	55 min.	65 min.	
4 inch	55 min.	65 min.	60 min.	70 min.	45 min.
4½ inch	60 min.	70 min.	65 min.	75 min.	
5 inch	65 min.	80 min.	70 min.	85 min.	55 min.
5½ inch		85 min.	80 min.	90 min.	

*For best results all tires should be cured on the arm about thirty minutes after mould cure.

Plain tread tires not being as thick, the time can be slightly reduced when curing.

GIANT PNEUMATIC CURING TIME

Using Triple Cure Method

Tire Size	*Number of Plies*	*Cure for Carcass Section*	*Tread Section Additional Each Cure*
6 inch	10	100 minutes	110 minutes
7 inch	10	100 minutes	120 minutes
8 inch	12	110 minutes	150 minutes
9 inch	14	120 minutes	160 minutes
10 inch	14	120 minutes	170 minutes

Using Steam Bag

One Cure Method, 60 or more pounds of steam in bag.

6 inch	150 minutes	This cure is usually made
7 inch	160 minutes	with one hour on air and
8 inch	170 minutes	balance on steam. Moulds to
9 inch	180 minutes	be at 50 pounds pressure,
10 inch	195 minutes	bags at 60 pounds or more.

Note: When using the arm, extreme pressure is required to bring the tire to the arm evenly and one hour or more should be used for curing in a boot.

When curing tread patches and boots in place of the complete section on heavy duty tires, the following table is used:

6 inch	90	minutes	at	50	pounds.
7 inch	100	minutes	at	50	pounds.
8 inch	120	minutes	at	50	pounds.
9 inch	140	minutes	at	50	pounds.

Inside cures on the arm, about forty-five to sixty minutes for all tires.

Tread sections and tread patches on fabric tires, ten minutes less than section.

Tread sections and tread patches on cord fabric tires, fifteen minutes less than section.

Semi-cure sections two-thirds of regular time when retread is also added. This stops side wall cracking.

When using impression pad, add fifteen to twenty-five minutes, according to the pad size, to allow for penetration through pad by heat.

Tube repairs are cured fifteen minutes at fifty pounds pressure. Red tubes less.

RETREAD CURING TABLE

When curing retreads in the kettle or pot heater, in many cases the pressure is reduced to forty pounds. However, the same table will work, as the valve control is usually arranged so that the pressure can be brought up gradually for good work. This is done to flow the gum slowly. Flowing starts at five pounds steam pressure (above 212 degrees), and the curing time is for pressure and curing.

FABRIC TIRE *With raw gum*	FABRIC TIRE *With band*	CORD TIRE *With band*
20 minutes to bring to 50 pounds. Cure 35 minutes	20 minutes to bring to 50 pounds. Cure 35 minutes	30 minutes to bring to 50 pounds. Cure 45 minutes
or	or	or
20 minutes to bring to 35 pounds. Cure 45 minutes.	20 minutes to bring to 35 pounds. Cure 45 minutes.	30 minutes to bring to 35 pounds. Cure 50 minutes.

DRY CURE TIME

When curing retreads in the one-third circle mould, the time of the complete fabric section cure should be used. For example, a three-inch tire forty-five minutes and a five-inch tire sixty-five minutes.

HOW VARIOUS REPAIRS ARE CURED

There are many ways of handling a cure of the repair. These depend largely on the kind of equipment in use or available in the shop. Many cures can be made on casing work that will not require the air bag in a complete sectional cavity cure.

Rebuilds.—Can be cured in the regular cavity, in sectional cures with air bag, in the kettle with endless air bag and rims or rings, or by use of special equipment built for this purpose, including tire moulds.

Retreads.—Cured in regular cavity in sectional cures with air bag, or in kettle using endless air bag with rings or rim, or by use of coil or segments; also in one-third circle retread mould of various types for use with air bag, sand bag, or rubber block.

Reliner.—Cured in regular cavity in sectional cures with air bag, on endless air bag and rings in

kettle, on the inside arm, or by special steam bags. Coils, blocks, or a sand bag will not bring pressure to play on the sides and at bead.

Complete Sections.—Cured in the regular cavity with air bag. Inside section and three-quarter sections are handled in the same manner.

Tread Section.—Cured in the regular cavity with air bag, or by use of sand bag, rubber block, or special patch vulcanizer which is used when placed on the arm to cure the inside section or reinforcement.

Bead Section.—All cured in the regular cavity with air bag, or side wall vulcanizer when pressure is properly applied.

Rebuilt or Rerun Sides.—(Including recovered bead or side patches). Cured in the regular cavity with air bag or side wall vulcanizer for proper pressure and including the complete repair.

Tread Patch or Side Patches.—Cured in the regular cavity with air bags, sand bag, or rubber block. Also with special blocks on hot plates or by special patch vulcanizers when used on the inside arm.

Inside Section.—Cured in the regular cavity with air bag or on arm in which a tread repair can be treated with special patch vulcanizer. By special steam bags or on inside arm.

Reinforcements and Puncture Patches.—Handled like inside sections.

Replaced Staples.—Cured in the regular cavity or on the side wall vulcanizer.

Tubes.—Cured on flat plate with direct pressure.

MOULD CAPACITIES

Tire sizes showing moulds, bead moulds, and bags used for curing sectional work and covering all types of plants.

SIZE		BAG USED	BEAD MOULD USED	MOULDS OR CAVITY IN WHICH TO PLACE, USING BEAD SPACER WHEN CARRIED TO LARGER MOULD		
				Standard measurement ending in ¾ inch	Measurement ending in ¼ inch	Measurement being single
3″	Regular	3″	3″	2½″ and 3″	3″ and 3½″	3″
3½″	Regular	3½″	3½″	3½″ and 4″	3″ and 3½″	3½″
3½″	Oversize	3½″	3″	3½″ and 4″	3″ and 3½″	3½″
4″	Regular	4″	4″	3½″ and 4″	4″ and 4½″	4″
4″	Oversize	4″	3½″	3½″ and 4″	4″ and 4½″	4″
4½″	Regular	4½″	4½″	4½″ and 5″	4″ and 4½″	4½″
4½″	Oversize	4½″	4″	4½″ and 5″	4″ and 4½″	4½″
5″	Regular	5″	5″	4½″ and 5″	5″ and 5½″	5″
5″	Oversize	5″	4½″	4½″ and 5″	5″ and 5½″	5″
6″	Oversize	6″	6″	Straight 6½″		
7″	Oversize	7″	7″	Straight 7¾″		

Special moulds are built for oversize heavy duty tires of six inches and up. These have proper bead moulds with the mould.

SETTING THE REPAIR UP FOR CURE

Inspect the repair for proper build-up. Trim and perforate. Determine kind of cure to be made and equipment to be used. Have the moulds and bead moulds clean and dust them lightly with soapstone if no other non-adhesive is used.

When putting the tire in the mould, see that all face cloths or pads are free of the bead, which should fit tightly to the tire. The straight side bead mould is applied after the tire is set in the mould. The quick detachable or clincher bead moulds are clamped to the tire when on the bench by using a clamp to hold them snugly in place. The clamp is removed as the bead mould is slipped in the mould. Should the bead

mould fit tightly, tap lightly with a rubber mallet to force into place.

Straight side tires of the clincher type with false beads, also regulars in an emergency, can be cured in

Figure 80.—Curing 40"x8" cord tire.

Q. D. bead moulds by placing a bead filler strip in the bead channel of the bead mould.

On cord fabric or cable cord tires of recent con-

struction an oversize will be found which should be cured in the larger cavity, using the undersize bead mould with spacer made of metal or wood. Doing this will eliminate flattened sides and a compressed repair which would, when inflated, crack and open up the gum down to the fabric. Buckles will also be avoided if this is followed, and the larger capacity mould that can be used will give better service from the repairs.

It is important in fitting all Q. D. tires that the bead moulds fit perfectly at all points on the tire bead, and that they come together. If, in building, the fabric has not bridged the bead channel, then padding will easily make a snug fit.

OPERATION FOR Q. D. TIRE SET-UP

1. Dust the tire inside and out with soapstone.
2. Fit proper air bag and pad if necessary. Should be the same size as tire.
3. Select the proper bead mould, apply soapstone and fit to the tire. If setting snug, clamp together with "c" clamp and see that bead mould comes together at all points. The tire is then hung on shelf or pipe.
4. If an impression pad is used, heat and tie it on or apply with patching cement, fitting every design perfectly. If necessary to save the non-skid, fill the design with a thick soapstone paste, first covering raw gum places with pieces of wet cloth also placed over the splice.
5. Wet face cloth and cover entire surface.
6. Place whole in proper mould, removing the "c" clamp as the bead mould falls in place. Tap down lightly with rubber mallet.
7. Tighten the mould clamp medium tight and inflate to fifty pounds of air, or as required, feeling the clamp after inflated so that a perfect fit is secured. Then bring up tight again.
8. When cured, let air from bag and release the clamp, removing the tire and bead moulds to the steam bench.

Remove cloth or pad, set bead moulds on shelf and slightly inflate the air bag.

9. Test and inspect the repair for cure and trim for appearance.

10. When not curing properly, the air, water, circulation, and heat conditions should be examined.

When setting up a plain tread tire, the face cloth

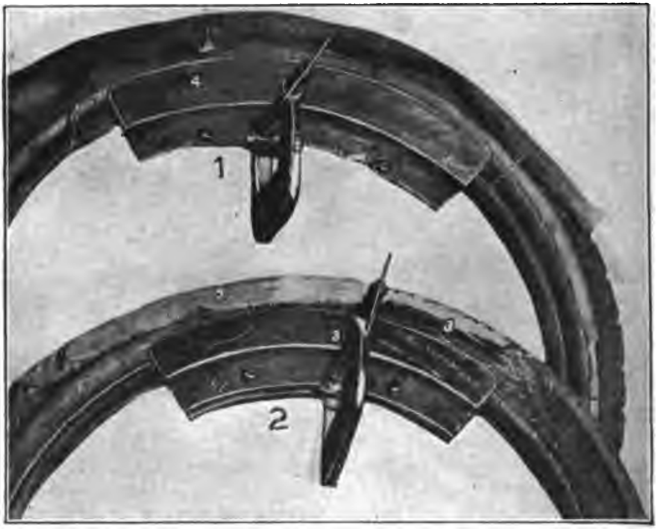


Figure 81.—Locking up bead moulds. 1—impression pad. 2—heat cloth only.

is applied wet and the set-up is similar. By following this operation, retreads or additional cures can be made completely around a tire, care being taken to fit all designs and center them on non-skid or ribbed tread tires.

Rebuilt tires can be semi-cured in this manner and

Figure 82.—Setting up section. Left—inserting pad and air bag. Right—placing in mould.

treads applied later. Sections in heavy duty tires are cured in the same manner and the tread section applied later and cured, two cures being necessary to replace the tread section removed for sufficient space to clear the mould. Should large tires of the heavy duty type be rebuilt for cure, a second side wall is applied when adding the band on the last cure in sectional work. This prevents an overcure of the single side wall.

MAKING NU-REBUILDING STEAM BAGS

Reference has been made in many cases to the method of vulcanizing reliners or new fabric in casings by use of the steam bag, an operation that is simple in itself when used by the good repairman. The writer, in 1917, experimented and originated the double valve steam bag for this work, and has used it to good advantage up to the present time.

Out of over twelve hundred casings vulcanized by this method, approximately eight have been returned, and these showed evidence of bad bruises. The general mileage runs from 4,000 as high as 8,000 and 10,000 miles. This repair is used when the carcass is weak or the side walls are broken. In fact, on retreads, the nu-build is used in most cases. Three-ply fabric reliners can be secured or cut out of old casings.

Theory of Operation.—Under this method of repair, a steam bag or tube is made with two valves. One valve extends through the tube down to the bottom of the tire and allows for the escape of condensation and circulation of the steam. This condensation passes out of the tube through a small pet-cock while the

Figure 83.—Cured repairs. Top—seven inch cord section semi-cured, before tread section is added. Bottom—semi-cure on seven inch rebuild before adding side wall and band.

steam pressure, usually of fifty pounds, is brought in at the top valve.

The tube is placed in the tire after the new fabric or reliner has been placed and fitted evenly. A slight inflation of air is then applied for wrapping either by hand or machine. A small air valve is welded into the tee for this purpose. When properly

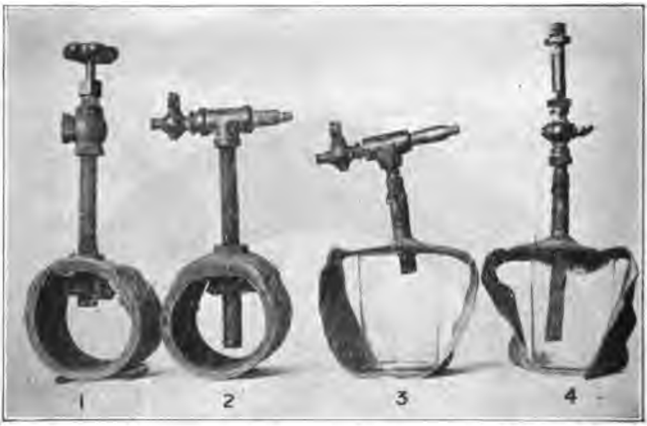


Figure 84.—Steam bag valves. 1, 2—metal valves. 3, 4—rubber valves.

wrapped, the tire is hung up and the steam line attached and turned on slowly, which forces the tube with hot steam against all parts of the new fabric or reliner. The pet-cock on the bottom valve is open slightly to create circulation and allow escape of water out of the tube. A cure of approximately one hour is used, or slightly longer in larger casings. When the steam bag is to be removed, cold water is

forced into the upper valve for the purpose of cooling the bag, and this water is left in the tube to keep the bag fresh and in shape until used again.

Making Valvès.—Any repairman can make either metal or rubber valves for use on these bags. Metal valves were originally used, but were found to cut through the tube under pressure, allowing for only six to ten cures per bag. With rubber valves, it was found that thirty to sixty cures could be had with a certain amount of care.

To make rubber valves, a small tube plate was first secured, and through it were drilled holes to take 3/8-inch pipe. The 3/8-inch pipe is welded through the tube plate at both ends and the upper end is rimmed to give a bell shape to the gum applied to the hose and to hold the valve together when cured. A piece of hose, approximately seven inches long is then built up to a fabric pad, and a piece of fabric fitted over it to wrap around the outside of the tube. The tube gum is then built up to allow for the bell reinforcement. After this, the hose is placed through the pipe in the tube plate, with the raw gum fitting in the hollow bell. A piece of flat metal with holes bored to slip over the hose is applied and pressure is exerted with two "c" clamps. A small round core should be inserted through the hose while the cure is being made, which is usually thirty minutes, after which it is removed.

The hose is always made long and the end cut off for the upper valve when applied to the tube. A piece of copper tubing is inserted in the hose on the valve to fit from the top of the bell to the end of the hose inside of the tube. A metal insert for

the upper valve is also made to fit in the upper end of the hose, which is clamped or wired to the valve,

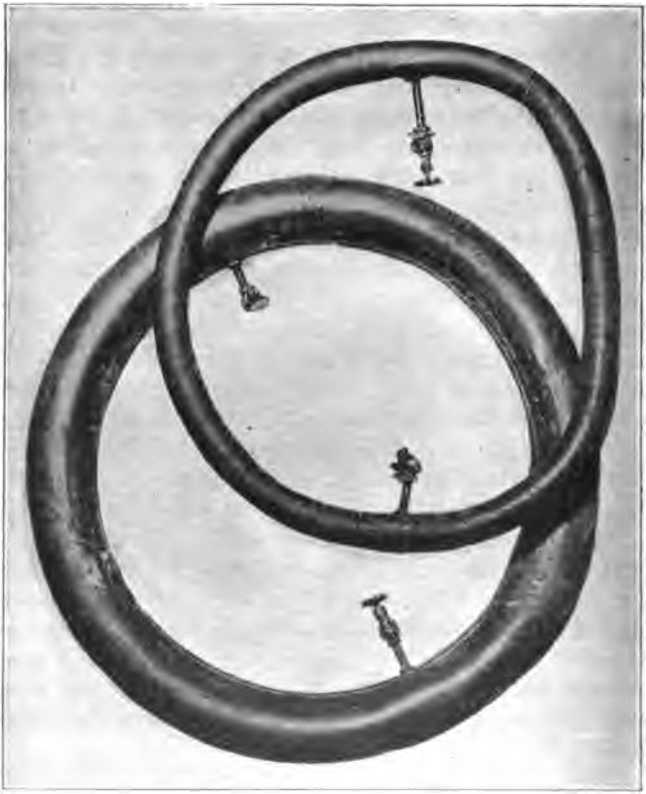


Figure 85.—Steam bags used for curing reliners in tires.

and a ¼-inch tee is applied on one end. On the tee is welded an air valve for the purpose of inflation.

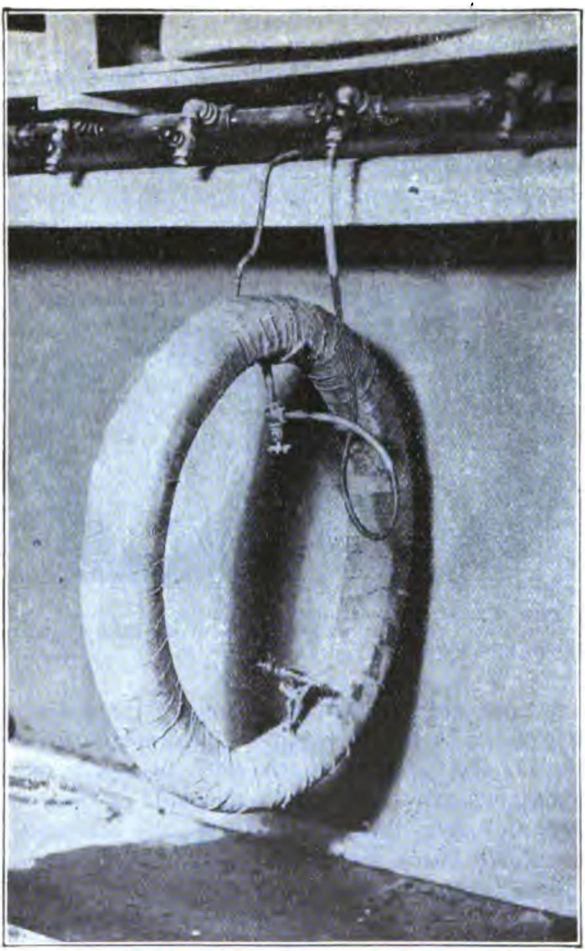


Figure 86.—Steam bag in operation, hand wrapped.

To the other side of the tee a small gas cock or valve is applied to let off steam or to hold air. A small coupling is applied for attachment to the steam line.

For the lower valve the insert is made and a common pet-cock applied to hold steam pressure and also to allow an opening for the escape of water and air. This pet-cock is kept slightly open while curing.

Making the Steam Bag.—Take a common tube of

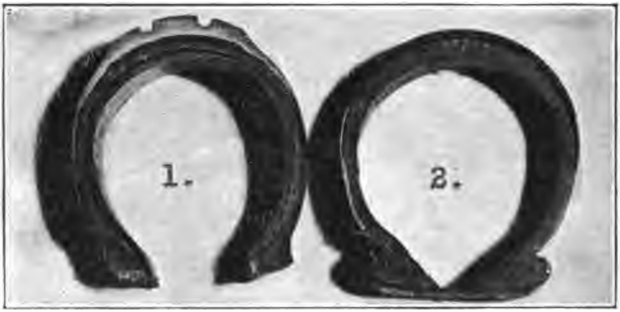


Figure 87.—Cross section of nubuild. 1—cured reliner and cushion, retread added. 2—cured reliner without cushion, two ply.

the proper size, and buff, removing the valve and valve pad. In the tube cut two holes opposite each other for the valves. Cement with two coats of vulcanizing cement, cement the under side of the rubber valves and wrap the fabric. Insert the hose ends on the rubber valve into the tube, and stitch down, wrapping the fabric completely around the tube. Inflate slightly and wrap the entire tube with bead fabric cut two and one-half inches wide and on the bias. Cut a piece of fabric wide enough to lap in

one piece around the tube, or use a good ply of fabric from an old casing, cemented. Build this around the tube. It is now possible to inflate the tube to about twenty pounds or more and cure the valve in the ordinary mould by drilling a hole to fit the hose coming up in the bead mould, or the valves can be slowly cured under the first cure in the tire. The lower valve should come down inside the tube to within one-half inch of the bottom.

Set Up.—After the fabric or reliner has been applied inside the tire so to come up to the toe of the bead evenly, soapstone the inside of the case and also paint the steam bag with a wet coat of soapstone. Apply the bag in the tire, taking care to get an even fit and to keep the beads evenly applied to the bag. Wrap with two wrappings of good strong ducking, having a slight amount of air in the tube for even work. Wrap well near the valves. Hang it up on the curing rack and connect the steam line coupling. Turn the steam on slowly until the pressure is up. Open the pet-cock at the bottom to allow for the escape of all water left in the bag, and keep slightly open while the cure is going on to allow water to escape from the bag. Cure from one hour to one hour and twenty minutes at fifty pounds and fill with water when completed by applying water line to bag in place of steam line. Keep the bag partly filled with water and remove carefully. Trim edges and paint.

Flexible hose connections and quick acting couplings can be secured for this work and a capacity can be arranged for curing thirty to fifty tires a day at small expense. The principal thing to remember

is that creases will weaken the tube if not fitted smoothly and cooled before removing.

ARM SET UP

Applying tires of any size to the inside arm is only a matter of wrapping them tightly with a wet cloth about three inches wide and in rolls. After the cloth is applied, a tightening device is used to bring the cloth up tight and to apply pressure on the repair. A special patch vulcanizer with curvature can then be applied and strapped on the upper surface for the curing of patches, etc.

SAND BAGS, RUBBER BLOCKS, OR CORES

Be sure to center tire at all times. In using the one-third circle retread mould of various types, the tire is placed in the mould, and the N. S. is protected by impression pads or by grooves in the mould. Use castile soap water for new gum. The sand bag or block is then inserted in the tire and a curved metal bar placed over it, to which clamp pressure is applied. The bag, like the rubber block, can be used in short circle moulds.

Iron cores for small patch work on flat plates have a curved block to take the curvature of the tire and lay flat on the plate. A corresponding form fits inside the tire and pressure is applied from above by a bracket attached to the regular plate clamps. The tire should always be set in the mould for each cure as for the previous cure. Perfect pressure must be had to eliminate low spots and, if necessary, more clamps should be attached. End blistering can be prevented by wrapping with wet cloth.

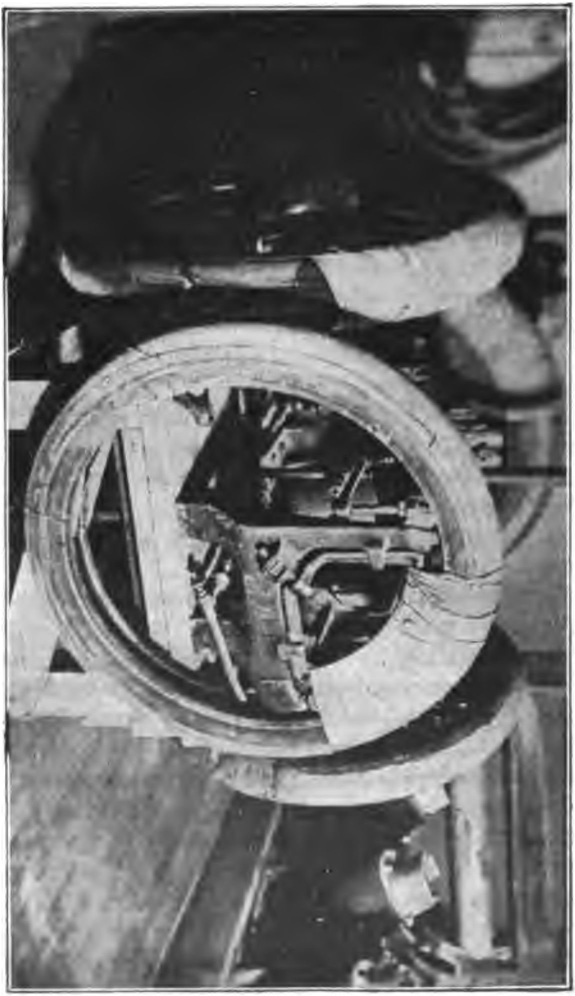


Figure 88.—Curing inside section on arm.

SETTING UP RETREADS FOR CURE

There are several methods in which the retread can be set up, depending entirely on the equipment facilities that the shop may have. It rests entirely with the repairman as to which is the practical operation for him to follow. Any one may be selected from the following:

1. Regular mould cure as explained. Dry cure.
2. Retread mould, one-third circle, as explained. Dry cure.
3. Endless air bag and split rims for kettle cure. Wet cure.
4. Endless air bag and rings with clamps for kettle cure. Wet cure.
5. Coil or segment and split rims for kettle cure. Wet cure.
6. Coil or segment and rings with clamps for kettle cure. Wet cure.
7. Coil or air bag with shaping rings only and with bead protectors. Wet cure.

In split rims, two types are available, one having a bead channel only and bolting together, while the other type with side flanges coming up the side wall, can be obtained in both heavy and light construction.

Two things are essential for serviceable retreading when curing: One is to have absolute pressure, by tight wrapping, on all parts of the tire; the other is proper cure by bringing the steam up properly and keeping water out of the kettle when curing.

In all cases where wrapping is done, either by hand or machine, a wet muslin or cloth is prepared in rolls about three inches wide and tightly wrapped around

the set-up after the coils, rings, etc., have been applied. Side strips should be used to protect the side wall in all cases where a side flange is not used. These strips are composed of fabric or tread gum of about four-ply, stepped down at the top and fitting against the rim or ring. The strip is soapstoned and applied to both sides. Patching cements can be used after the strip has once been cured. This cement will hold it in place while wrapping and can be easily removed after cure.

SET-UP WITH BAG AND RIMS ON RINGS

1. Soapstone the tire both inside and out.
2. Select proper size bag, and if necessary, pad with old inner tubing.
3. Insert flap for protection to bag and apply light body of air.
4. Apply split rims and bolt together.
5. Apply side pads. Fill rib or design with soapstone and apply cover cloth, or, if wrapping impression pad is used, apply the pad.
6. Wrap by hand or machine with two plies of muslin, having absolute pressure and keeping even.
7. Inflate to same pressure as used on the steam line.
8. Cure in kettle according to table.

The set-up for air bag and split ring is handled in the same manner, except that clamps hold the rings and are removed as the tire is wrapped.

SET-UP WITH COIL OR SEGMENT WITH RIMS OR RINGS

1. Soapstone the tire both inside and out.
2. Insert a reliner or old inner tubing to prevent marking from the coil.
3. Insert coil of proper size to fit evenly.
4. Insert flap to provide as much bead pressure as possible.
5. Apply split rims and bolt together.
6. Apply side pads, fill in rib or design with soapstone and apply cover cloth, or impression wrapping pad if used.

7. Wrap by hand or machine with two plies of wet cloth or muslin, applying all the pressure possible.

8. Cure in kettle according to tables.

When using rings, the same operation is followed.

The use of the rings and rims may be dispensed with by applying the coil and wrapping the tire as explained, after which a circular shaping ring is set inside the tire to keep it from sagging out of shape when hanging in the kettle. If of an upright type, however, the bead should be protected by using a side pad to fit evenly.

Figure 89.—Wrapping retread for kettle cure.

In opening the steam valve to all kettle cures, and when small boilers are used, the suction caused by opening the valves too wide will draw the water out of the boiler into the kettle. If the water were allowed to remain, it would cause a poor cure where it touches the tire. Open the valves slowly to overcome this condition. If not successful, due to plant conditions, place a common air valve at the top of

the kettle and apply air pressure equivalent to the steam pressure. This will give control of the kettle and a small pet-cock opened slightly will allow the gradual escape of air as the steam comes up and will overcome the syphon action otherwise created.

OPERATION UNDER DRY-CURE RETREADING

In dry-cure retreading, the repairman must turn out quality work, and, while it might be possible to merely get along on poor sectional work, no one ever made a success of the repair business in doing haphazard retreading. Dry-cure retreading requires all the qualities necessary to the expert vulcanizer. Third circle moulds have always given a certain amount of trouble, even to the experienced man when he starts using them, and it is not as easy as many claim to turn out satisfactory retreads unless expert workmanship is combined with intimate knowledge of stocks and proper equipment. Third circle retreading requires a general knowledge of equipment and proper fitting of the tire. No third circle mould will turn out a perfect job unless the repairman specializes on this line of work and has a sufficient amount of good old-fashioned common sense.

In making a study of the required cross-sectional widths of various size tires, such as Goodyear, Firestone, Goodrich, Miller, General, Mohawk, Kelly-Springfield, Portage, Republic, Fisk and others, it is found that cross-sectional diameters of all $5\frac{1}{2}$-inch fabric tires are about the same, measuring approximately $5\frac{1}{4}$ inches; that in the 5-inch cords, the cross-sectional diameter is $5\frac{1}{16}$ inches on the smaller makes

and 5½ inches for the larger. Other sizes are as follows:

5″	fabrics	are	5 1/16″	maximum and	4¾″	minimum
4½″	cords	are	4 15/16″	maximum and	4⅝″	minimum
4½″	fabrics	are	4 9/16″	maximum and	4¼″	minimum
4″	cords	are	4 7/16″	maximum and	4 1/32″	minimum
4″	fabrics	are	4⅛″	maximum and	3 13/16″	minimum
3½″	cords	are	3⅞″	maximum and	3⅝″	minimum
3½″	fabrics	are	3 11/16″	maximum and	3 3/16″	minimum
3″	fabrics	are approximately 3 inches				

These are the sizes when new. When used for some time, there is a spread or expansion of from ⅛ inch to 3/16 inch and sometime as much as ½ in. In some makes, there is a still greater width shown.

It can readily be seen in fitting the various sizes to retreading moulds that in order to give the best results, the mould must be able to take sizes from 3 inches to 5½ inches. It is not practical to try to force a 5-inch cord tire with a diameter of 5 1/16 to 5½ inches into a mould measuring only 4¾ or 5 inches across, as the fit is not perfect and trouble will come up later, due to the compression used.

Some manufacturers of retreading moulds make the sizes in two moulds per set, while others use three moulds per set, to take care of the range in diameter. The two-size sets take care of the average retreading up to a 4½-inch size in good shape. However, above that size, the three-mould set is recommended for best results.

Due to the various size cords now in use and to the oversizing of regular tire sizes, the repairman will do better to use the mould that accommodates the tire as to actual fit, in place of putting the tire in a mould

just because it is marked the same size. Better results will be obtained in this manner on retreading because of the wide difference in the cross-sectional diameters of different makes of tires.

Figure 90.—Dry cure retreads showing first and complete cure.

In setting up tires for third circle moulds on retreading, the following procedure is used:

1. Dust side walls of vulcanizer lightly with soapstone. If aluminum matrix is used do not use lubricant of any kind. Side walls should be kept from sticking by mixing a little mica or soapstone with some vulcanizing cement containing gasoline, and brushing this on the iron moulds.

2. Fit sand bags in the tire, taking care to select a bag that fills out the tire at the bottom in good shape. Place spring on the bag to fit in the mould; turn down clamp, using the center clamp first in all cases, then the outside clamp, with all pressure possible. Then tap pressure bar with a machinist hammer to overcome any resistance to pressure, and which allows tightening clamps still further. This covers the first cure.

3. On the second cure, turn down the clamps on tread joint first, following this by center and outside clamps. Retread will not blister if pressure is solid and even.

DRY CURE RETREADING INFORMATION

Many repairmen have had difficulty in this kind of work due to the low spots in the cure, to improper flowing of the stock or to sticking of the gum on the moulds. All of this may be quickly overcome by using the suggestions as given.

The first thing necessary for success in retreading is to select a good carcass which has strength and which is not permeated by oil or water. Then use the best cement, cushion, breaker and tread stock, preferably those of a long cure type. They will not show an overcure in the splice, but will remain resilient under a second cure. The new retread should be kept narrow if possible.

Lubricants and Cleaners.—Improper flow or sticking of the gum is due in many cases to sticky or gummy moulds. The moulds should be cleaned regularly. Moulds may be cleaned by using wire wool or fine emery and they may be washed out with a solution of one ounce of hypo in one gallon of water. This

solution may also be brushed in and used as a lubricant.

The following lubricants can be used after the moulds have been cleaned:

Figure 91.—Cured retreads. 1—pad cure in mould. 2—band cure in mould. 3—wrapped kettle cure. 4—plain mould cure. 5—pad cure in mould.

1. Castile soap dissolved in water to a liquid and brushed on.

2. Soapstone and water brushed on the mould or the tire.

3. Vulcanizing cement brushed on the tire.

Figure 92.—Dry cure retreads. Showing ribbed and non-skid retreads properly applied in one-third circle moulds of both solid and removable aluminum matrices.

4. Glycerine, mica and gasoline brushed on the mould.

5. Paraffine and mica rubbed on the moulds.

The above lubricants are not required on aluminum moulds as these need no such treatment.

NON-SKID RETREADING

Some retread moulds are designed for non-skid retreading. The matrix is removed for this type, being set in place with screws. The matrix is adjustable in the moulds, with proper connection on the last cure. The first cure is taken in the regular way. In the second cure, one end is matched and carried on. On the third or last cure, one end is matched, the matrix bolt at the other end is loosened and raised until it fits on the first non-skid cure. When a fit has been made, tighten the matrix bolt and remove the tire from mould, using a strip of tread stock to lay in the section.

In some cases, bad joints are encountered on the non-skid matrix. It is only necessary to cut out the bad portion of the tread, change to a plain matrix and cure in short section smooth tread. Soapstone the non-skid on both sides of the joint.

Sand bags can be made from junked tubes, fire hose or ducking, and should be long enough and made so not to pinch the side walls. For filling, either good sand or coarse salt can be used.

In many cases on retreading it is necessary to put a section on the tire, in which case the section should be slightly undercured. This will stop the side walls from cracking under expansion when the tire is inflated. The double cure on side walls will have a tendency to overcure the gum, unless the sections are first semi-cured.

The retread, once placed in the mould, should

always be cured in the same mould, and the same fitting can easily be secured by paying attention to the joint before bringing up the clamps on the other cure.

In the selection of sand bags, the bag should be small enough to avoid pinching the side walls on the edge of the moulds.

CHAPTER IX

EQUIPMENT AND SHOP REQUIREMENTS

EQUIPMENT

The selection of equipment depends greatly on the volume of vulcanizing to be secured and the methods of repairing that are to be used. The equipment should be standard and practical for turning out the work quickly and with neat appearance. The best quality should be installed, as vulcanizing equipment is always in demand.

There are three distinct types of plants in use; the air bag, the rubber block, and the wrapped. All three of these will, under their method, do vulcanizing. The air bag system requires a set of metal bead moulds or cores to encase the bag in the tire when inflated and cures the entire section in a mould or cavity fitting the tire size. In the block system, use is made either of rubber or wood blocks reinforced with metal. Part of the tire is cured in the mould and the block is moved to apply pressure to other parts if curing a complete section. The wrapped system of curing consists of vulcanizing the inside repairs on an inside arm, and a patch vulcanizer is applied to the exterior for an outside cure if needed.

The advent of the steam bag used on large tires for inside curing in the mould, or alone when wrapped, is a combination of the regular systems.

Any of the foregoing systems can be used exclusively, or, in a large shop, all may be included to advantage in turning out work rapidly. The air bag in large sectional work is much in demand, while rubber

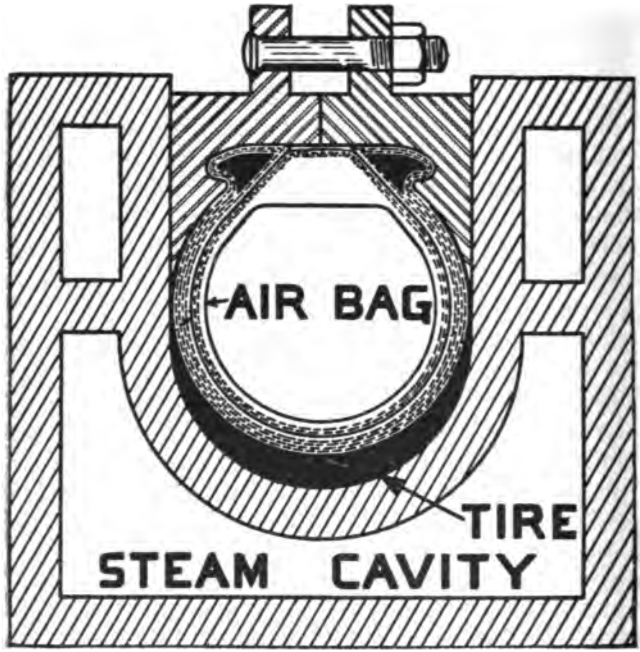


Figure 93.—Air bag curing system.

blocks and sand bags are used extensively in retreading tires in one-third circle moulds. The use of an inside cure with patch vulcanizer on surface work and inside sections and reinforcements leaves the moulds open for larger repairs.

Makers of equipment manufacture many items that facilitate shop work, each manufacturer having a device different in operation, but doing the same work.

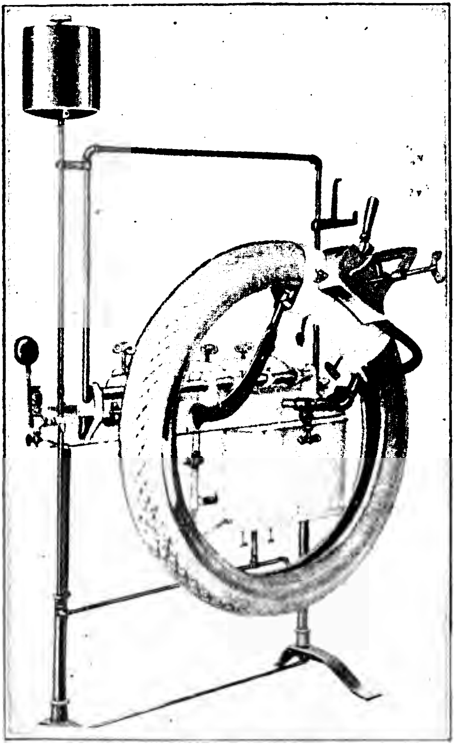


Figure 94.—Wrapped curing system.

Ordinarily the equipment can be secured from one company carrying an assortment sufficient to take care of the volume of work in a territory. Again, it

may be necessary to purchase from more than one company to equip to advantage; this selection depend-

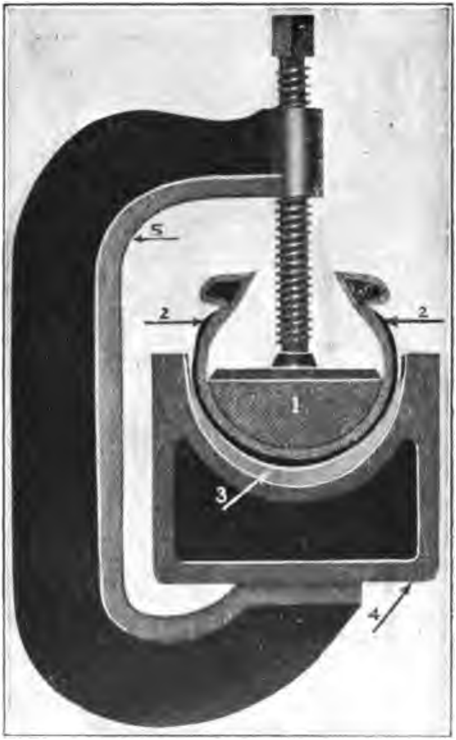


Figure 95.—Clamp and block curing system.

ing on the type of plant to be used or the sizes and extent of vulcanizing to be handled.

Due to the many items of equipment made, the following information is assembled to fully describe

all kinds and the uses to which they can be put in either a small or large shop.

BOILERS AND BURNERS

Boilers.—Can be classed as two kinds, tubular or flue boilers, and coil boilers. Flue boilers range from

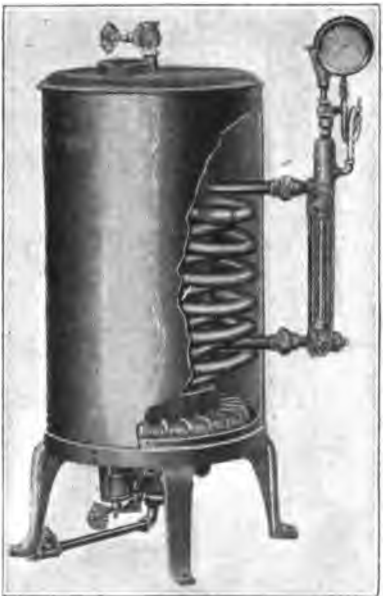


Figure 96.—Coil boiler for gas or gasoline.

4 to 10 H.P., depending on the mould and kettle capacity, and on the system used for heating. A 4 H.P. boiler heated by coal, city gas, or oil will take care of ten moulds, two arms and tube plates nicely,

or would handle a large kettle when the line is cut over to run alone.

Figure 97.—Large coal burning boiler.

When a large battery of moulds and kettles is used, a 6 or 8 H.P. boiler heated in the same manner should

be secured. On non-return systems in large plants as high as 10 H.P. boilers are selected.

Coil boilers, usually heated by city gas or gasoline force feed systems, are used on small plants, being in most cases set up in a gravity system.

The position of the boiler in regard to the drain line of the moulds or kettle determines the kind of steam system in use. When possible, the boiler is

Figure 98.—Splinted flue boiler for gas or gasoline.

placed in a basement under city gas control (or coal or oil), with the mould line above the top of the boiler. This forms a gravity system; that is, the steam rises through the outlet at the top of the boiler and flows or circulates through the moulds. The condensation drains back to the bottom of the boiler through a pipe connection in which a check valve is

placed. This allows condensation or steam to pass in only one way.

When the boiler is placed so that the water line is above the mould line, only an outlet pipe is attached to the top of the boiler. This pipe carries the steam through the moulds or kettle. The drain regulated by a pet-cock or small valve, or a steam trap checks the pressure, but automatically drains all condensation or water as it fills up the trap. Pressure regulating valves can be placed on this system and a higher steam pressure carried on the boiler, then reducing the pressure for any part of the plant, each line of steam pressure being handled by an individual trap.

On the gravity return system, very little water is wasted, due to the condensation returning to the boiler. When the city water pressure is higher than the steam pressure, water can be put into the boiler by use of a check valve and with a water valve in the pipe which stops the steam from rising and blowing out through the water pipe.

If the steam pressure is higher than the water pressure, or if no city water is available, either an injector or force pump is attached to the boiler and water is pumped from a tank or barrel into the boiler. Water from the steam trap on non-return systems can be run into the tank and pumped into the boiler. The injector is used on all large boilers, as it will work against all pressures and is more practical than the force feed pump, with which considerable water is wasted.

Too much water should not be placed in the boiler, as it will not allow for steam capacity and will de-

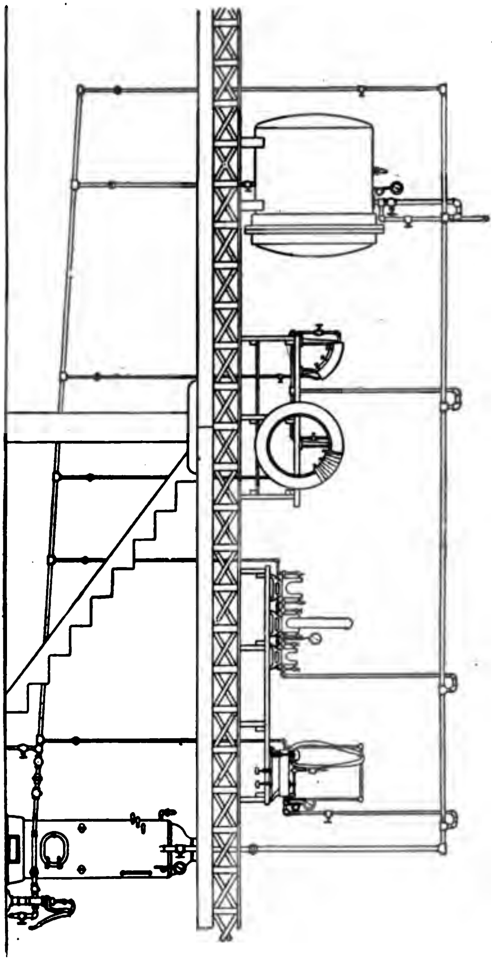


Figure 99.—Gravity return system. This system can be used whenever the boiler water line can be placed at least thirty inches below the vulcanizers. The greatest possible fall should be allowed between vulcanizers and boiler, using a drop of at least one inch to the foot in the return pipes. Two check valves are shown in the return so that the boiler cannot empty itself through this line.

liver suspended water in the steam when going through the moulds. All valves should be working easily on the water glass, so that both valves can be immediately turned off should a glass break. On small coil boilers the flame should be turned off immediately when the glass breaks. The boiler should be equipped with blow-off valve in good working order, which should be set to blow off at a safe pressure and should be tested frequently. A pressure gauge should also be applied.

Burners.—Several types of burners are made for use with city gas on flue or coil boilers, for gasoline on coil boilers, or on single moulds, plates, or portable sets enbloc. Burners are also made for use with crude oil. The city gas burner consists of hollow pans on which are set plates with small holes and the gas is regulated by a gas controller automatically shut off when a certain steam pressure is reached.

Gasoline burners work on a similar principle. The gasoline is delivered to the burners either by force feed from a tank under pressure, or by gravity. It is turned to a vapor by heating the burner, and the vapor is burned to show a blue flame. Control is had by turning the burners down or off when a desired pressure is reached, and opening them for more heat.

Oil burners are used very little and must be specially ordered, the type being explained fully when the burner is delivered. Gasoline burners are used extensively in towns without city gas. However, when available, the city gas will be found most practical and more easy to control on either a gravity or non-return system.

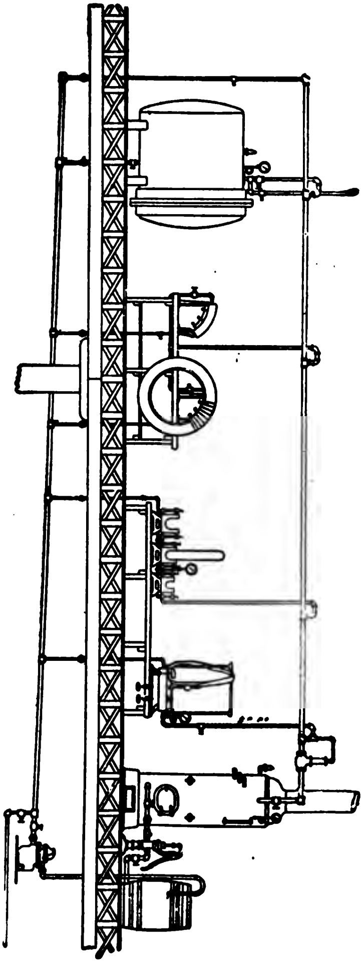


Figure 100.—Non-return system with one trap. This system is used when the boiler cannot be placed on a floor below the vulcanizers. A trap is placed in the return to remove the water and send it into a tank to be used again. A pressure regulating valve permits use of higher boiler pressure which is reduced to the amount required by the vulcanizers, thus maintaining even pressure at the vulcanizers regardless of variations in the boiler itself. Note that the steam supply for each vulcanizer is taken from the top of the main so that no condensation can enter the vulcanizers.

MOULDS, PLATES AND KETTLES

Moulds or Cavities.—For sectional work these are metal blocks of horse-shoe shape, having a hollow interior for the circulation of steam for heating the mould. All heat during a cure comes from the mould unless a steam bag is used. There are three different arrangements of the moulds as to size, and while they

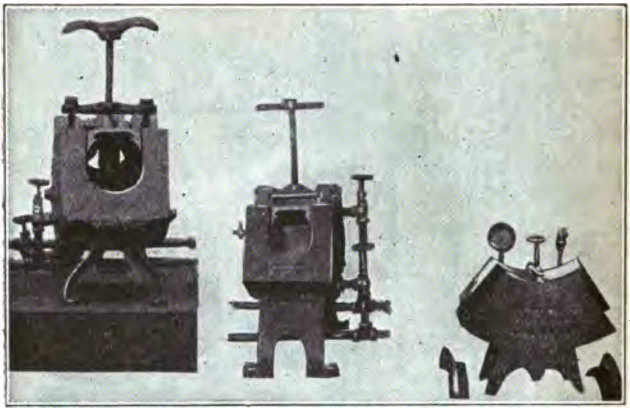


Figure 101.—Sectional vulcanizers. Left—Akron-Williams, single steam chamber. Center—Akron Rubber Mould & Machine, single steam chamber. Right—Chas. E. Miller, single steam chamber.

can be secured single, double, or enbloc containing one or more cavities, the sizing is of importance in order to designate the size tire that can be cured. Some makes have moulds that take two sizes of tires, while others will cure only the one size tire.

Three distinct sizes are available and the actual cross measurement of the mould will readily show

what sizes can be placed. For instance, a mould measuring 3¾ inches across will take 3½ and 4-inch tires and cure them properly. Should it measure 3¼ inches across it will take 3 and 3½-inch tires, and if measuring 3½ inches across it will take only the 3½-inch tires. These sizes are approximate, and, while some manufacturers state a larger range in sizes, this outline should be followed for good work.

Most manufacturers of the regular ¾ inch ending in mould measurements are now making a 5¼ inch mould for use in curing five inch cord tires. This goes with the unit plants, a shell being used to meet the regular size.

MOULD MEASUREMENTS

Ending	*Takes*
¼-inch	Even and next half size.
½-inch, or even	Individual sized tires.
¾-inch	Takes half and next even size.

Moulds are made in one-fifth or one-fourth circle, the latter being a longer mould and covering a longer space on the tire when curing. When equipping, the circle should be given. A one-fifth circle mould will have a curing surface in length of approximately 18 inches, while a one-fourth circle will take about 27 inches. Heavy duty moulds on six, seven and eight-inch tires take about 30 inches.

The square tread mould is used for curing truck pneumatic tires and when a round tread type of tire is to be repaired, a filler is placed in this type of mould. This is of greater advantage than equipping with two moulds of the same size, especially when square tread tires are in use. Square tread moulds

are made to fit the individual tire of most manufacturers and to allow for the oversize capacity. The cross measurements in inches are approximately as follows: 6 18/32, 7 15/32, 8 19/32, 9¾, 10⅜ and 12⅝.

Every maker will have a different clamp device for locking and applying pressure to the bead moulds, "c" clamp, and permanent sets.

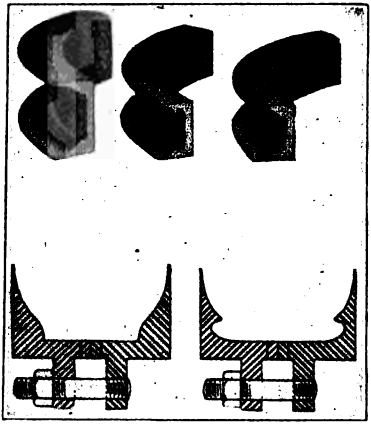


Figure 102.—Bead moulds used in regular shop work.

Some moulds are being made singly or enbloc and are adjustable for the various size tires by inserting metal blocks between movable sides. When set and tightened by a special device, these will allow for the circulation of steam through the adjusted moulds.

Retread moulds, usually in one-third circle and either single or enbloc, are used mostly for retreading or curing of tread patches. They are used with the

long rubber block or sand bag, and in most cases are of low height. Special retread moulds of a depth sufficient to take bead moulds and use an air bag are made in various sizes with three or more pressure clamps for plain, ribbed and non-skid work, solid or with metal matrix.

Figure 103.—Localized heat or triple chamber sectional vulcanizer, Akron Williams.

All moulds can be set up and connected in a line or battery to a large boiler, or can be secured in portable sets or singly for burner use.

Bead Moulds.—The bead moulds consist of two sides of machined metal grooved to fit the tire beads. They lock the casing of a tire in the mould and at the same time conduct the heat from the moulds. They run in sizes the same as the moulds, and can be designated by measuring or by fitting in the mould. Care should be used not to mix up bead moulds. They should be kept paired, as in most cases they are fitted to the mould when shipped. Some makers supply bead moulds, both S. S. and Q. D., with each mould

between 3½ and 5 inches, while others supply only one mould in either S. S. or Q. D., and it is necessary to include the others when equipping.

Bead Spacers.—Consist of a curved piece of metal which fits between the two sides of the bead mould when it is used in an oversize mould and in curing

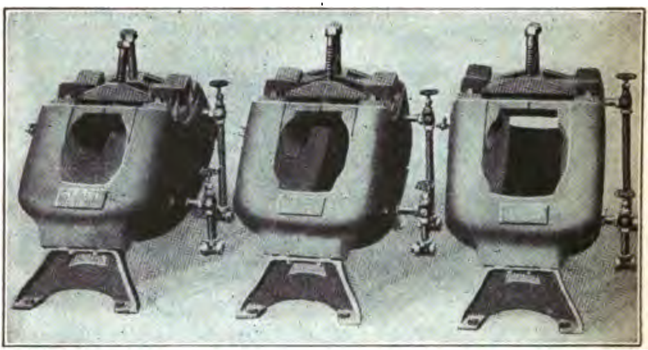


Figure 104.—Giant pneumatic square tread moulds. Made to accomodate the square tread type of tire. Round tread tires of most designs can be cured in this mould by using a filler of cloth or soapstone or by the use of an aluminum matrix.

oversize tires. It is of the same curvature or rim size as found in the regular or undersize. Exacting repairmen will find them practical for use.

Reducing Shell.—Is a machined metal form fitting into the mould and decreasing the size of the mould so that smaller tires can be cured. They can be secured in one-fourth-inch or one-half-inch thickness, reducing either a single size or, when one-half inch thick, down to a mould set of two tires. Should the one-fourth-inch size be used in double mould sets,

it is necessary to secure special size bead moulds to fit. In the one-half-inch size the regular (double) undersize bead mould can be used. The use of the

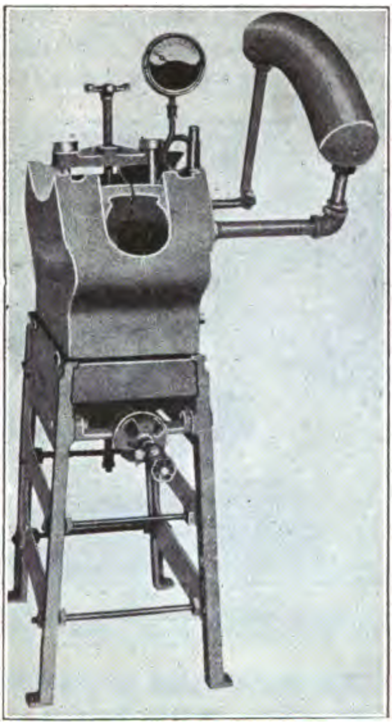


Figure 105.—Single sectional vulcanizer with gasoline burner.

shell allows a double capacity mould and it can be secured in any size.

Inside Arm.—The inside arm is useful in any shop

for curing inside repairs in place of using the mould and also for transferring large tires for cure of the reinforcement. They can be secured in all sizes similar to the moulds, with or without tightening devices for pulling down on the wrapping. The length up to five-inch section is approximately twenty inches, while seven-inch arms will run twenty-eight inches

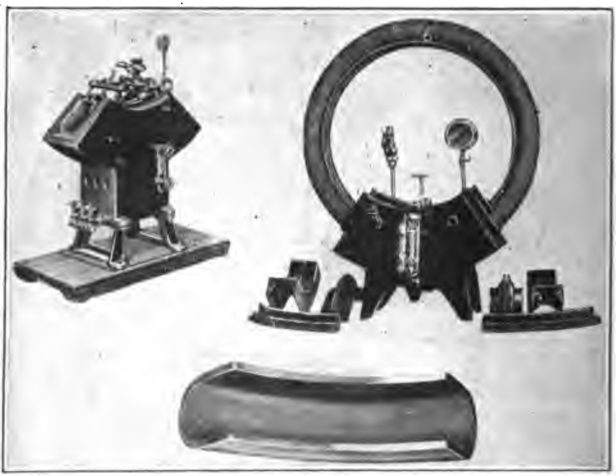


Figure 106.—Single sectional vulcanizers with gasoline burners. Reducing shell shown below.

in length. They are attached to the steam line, or on portable sets enbloc, or they may be secured from some manufacturers heated by electricity. Patch vulcanizers can be used to advantage with the inside arm.

Side Wall Vulcanizers.—Are used for curing bead and side wall repairs. They are made in sizes for use with an air bag or are used with metal sides

fitting either the S. S. or Q. D. bead, then being brought together by a bolt tightening device to apply pressure. The circle is usually one-fourth. They are attached to the steam line in the same manner as moulds.

Tube Plates.—Are made either of a flat, hollow metal block with machined surface for use on steam

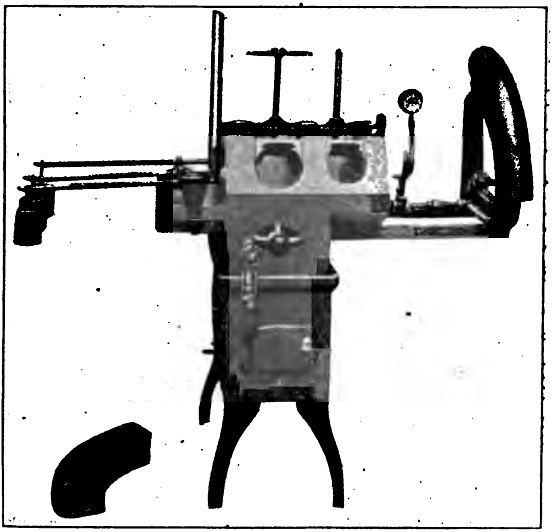
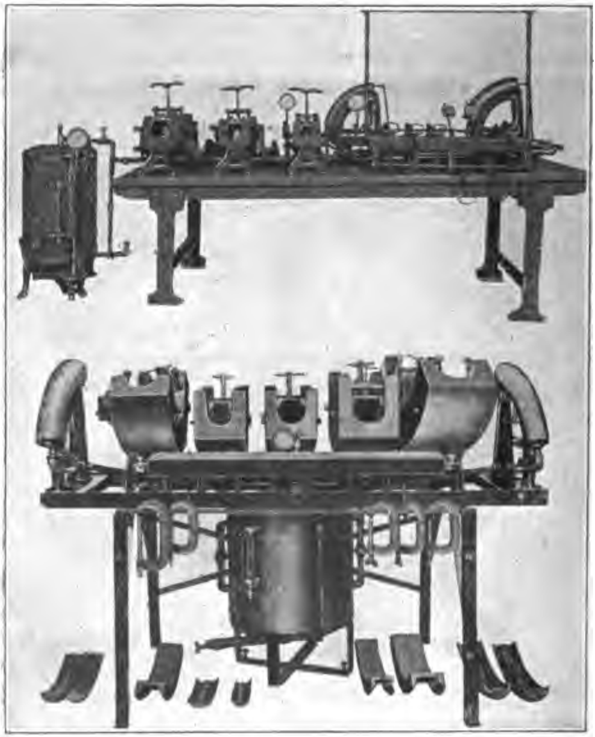


Figure 107.—Cavities and unit to cure 2½" to 5" tires using shell, Akron Rubber Mould and Machine.

lines or of special blocks for electric use. They are used for curing inner tube repairs, being made in various sizes.

Three kinds of pressure devices are used by various makers; namely, clamp, spring and weight. In the

clamp system a small "c" clamp is used mostly. The spring type varies; on some, the spring is centered, while others hook the spring on the cross bar coming



Figures 108 and 109.—Vulcanizing units and cavities en bloc. Top—Akron Williams Model "R" for 2½" to 5" tires, coil boiler attached. Bottom—Vanderpool outfit for curing 2½" to 5" tires.

over the plate. Weight systems apply a ball or bell of metal at distances on the cross bar coming over

the plate. The steam tube plate can be attached to the steam line or supplied with gas or gasoline burners.

Tube Vulcanizers.—Of the small type for repairing single inner tubes consist of two metal plates brought together under pressure. One plate is heated by gasoline, electricity, or by saltpeter patches in containers made to hold the inflammable material. Some

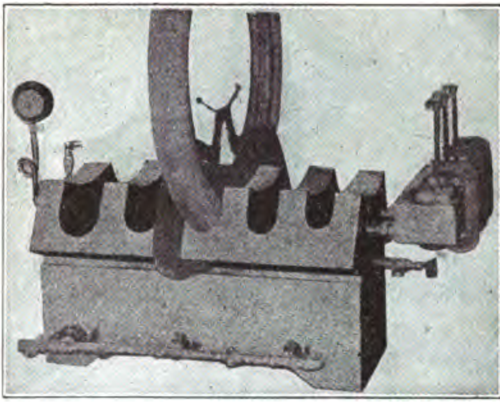


Figure 110.—Craft unit for curing 3" to 5" tires in single sizes.

types of this vulcanizer can be secured for repairing small surface patches on casings.

Patch Vulcanizers.—Consist of a hollow surface block grooved on two or four sides to fit the contour of different size casings. It is applied to the tire when on the inside arm by means of a chain fastening device or by special clamp pressure. The block is connected to the steam line by a flexible steam hose and

a pet-cock is used for the slow escape of the steam to keep up the heat. Electric patch vulcanizers are also available for this same use (flat). On the steam connection it is more practical to attach two flexible hoses and secure complete circulation, having the pet-cock for blowing off all pocketed air, etc.

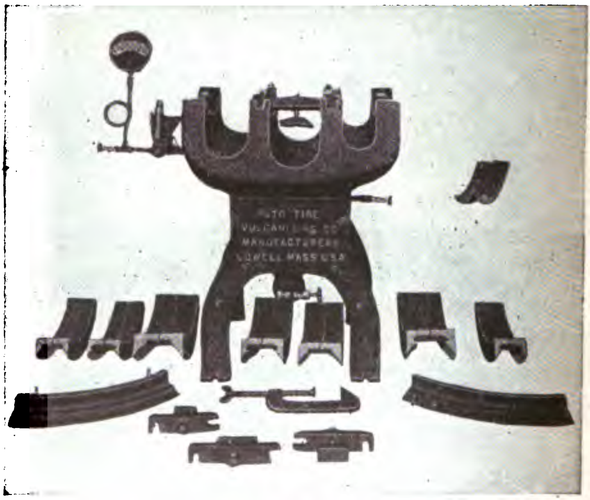


Figure 111.—Cavities en bloc for 3″ to 5″ tires, Lowell.

Retread Kettles.—There are two types of kettles in use: One, termed the flat kettle, has a weighted top or a top raised by a large wheel and turnbuckle. The top is made steam tight by use of a special packing ring or by large bolts which are placed and tightened. The capacity of this kettle will range from three to

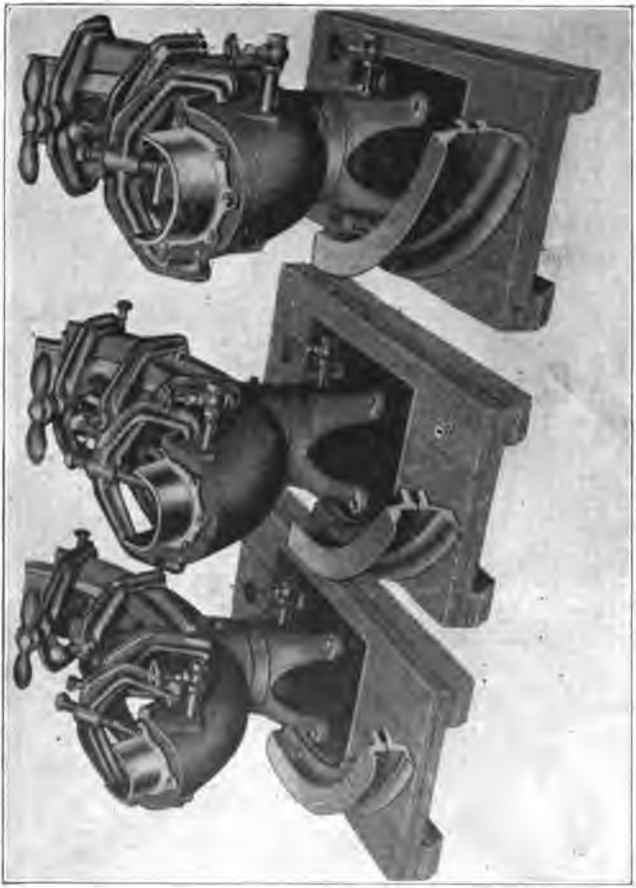


Figure 112.—Dry cure retreaders.

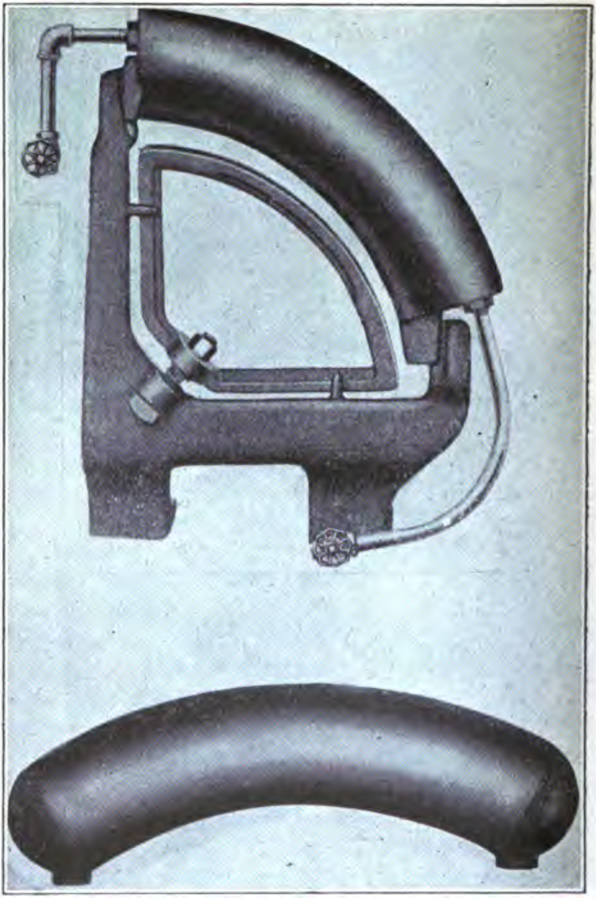


Figure 113.—Inside curing arms. Upper-bolt pressure type. Lower-hand wrapped type.

Figure 114.—Inside curing arms. Upper-handle pressure type. Lower Thumb screw type.

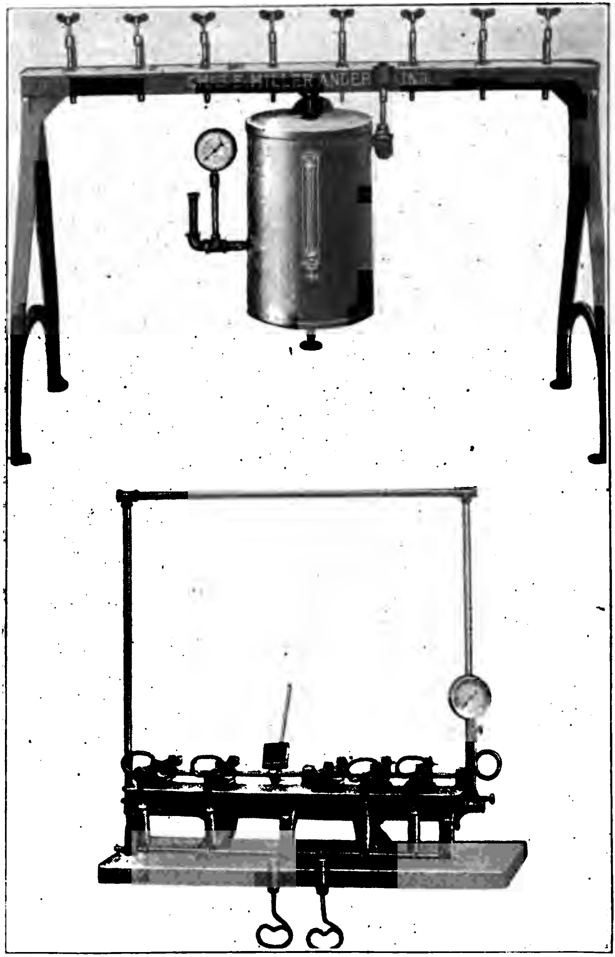


Figure 115.—Tube vulcanizers. Upper unit has hand "C" clamps, lower uses spring pressure.

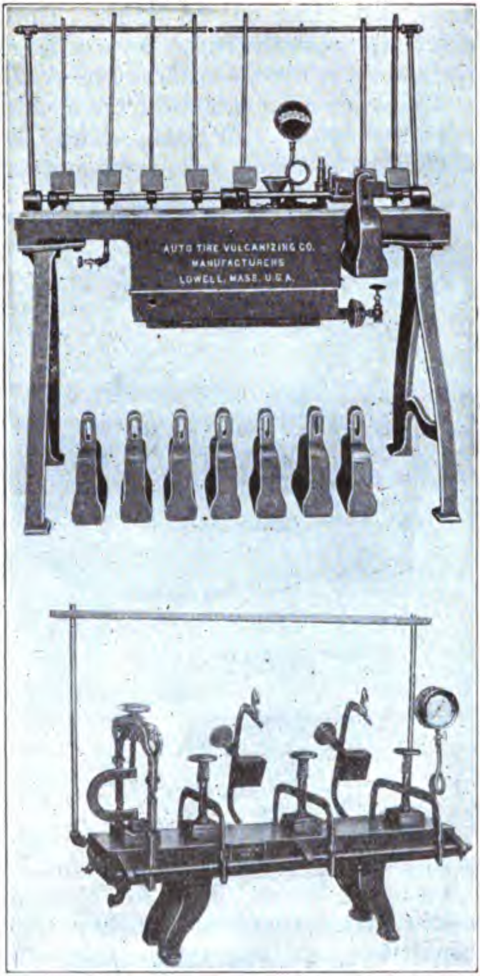


Figure 116.—Tube vulcanizers. Upper unit uses weights for pressure, lower uses springs.

eight tires, depending on the maker. Upright kettles, taking up to twelve tires, have a large hinged door which is sealed by use of heavy bolts after being closed. The smaller flat kettles of the doughnut type can be operated with a coil boiler. Large boilers are required for kettles taking over three or four tires.

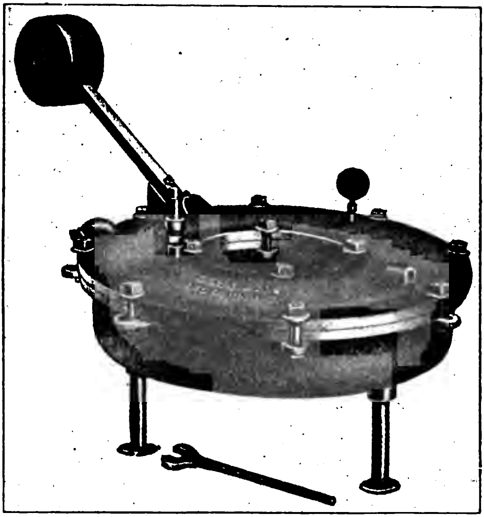


Figure 117.—Retread kettle, two to four tire capacity.

OTHER EQUIPMENT

Retread Rims.—Consist of a rim split in two halves made to fit either S. S. or Q. D. tires and bolted together on a center flange. They can be secured with bead groove only, or with side flanges which come about two-fifths of the way up the side wall. Some have a special inside metal filler which holds the bead

in place while curing. Used with coil, segment or endless air bag, or a special steam bag. Made in sizes and taking oversize tires.

Retread Rings.—Similar to the rims except that

Figure 118.—Retread kettle, four tire capacity.

they fit the bead, and are held in place by special clamps which are removed as the tire is wrapped. Used with coil, segment or endless air bag. Made in sizes and taking oversize tires.

Retread Coils or Segment Cores.—Used for inserting inside of tire when retreading. In sizes singly. Can be used with rims or rings, or without them when using bead pads and ring.

Electrical Retreading Equipment.—A special method of retreading various size tires by the use of

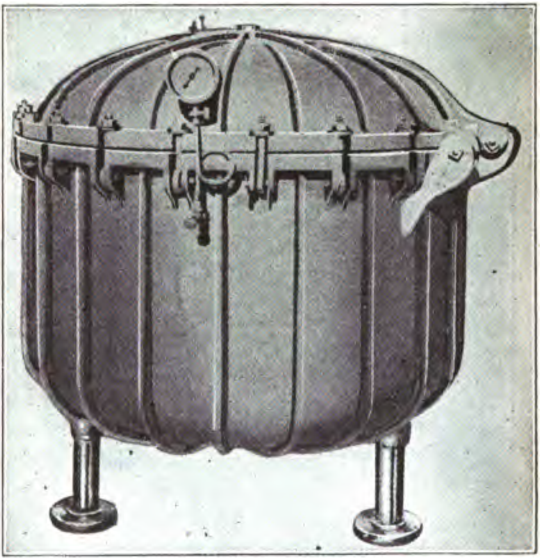


Figure 119.—Retread kettle, four to six tire capacity.

wires placed in the cushion stock which is allowed to remain after cure. A rheostat is employed and current is supplied to the wires projecting under the side of tread.

Endless Air Bag.—A special wrapped inner tube for placing inside the tire during retread to apply

pressure from inside. Made in sizes and used with rims or rings.

Steam Bag.—A special prepared sectional bag used in place of the air bag for inside cures of casing repairs. Special steam tubes for complete curing of reliners in sizes are also in use. Practical when used by experienced repairmen.

Figure 120.—Retread kettle, five tire capacity.

Buffer and Brushers.—Used for cleaning, roughing, and buffing tires and tubes. Consists of base, head and counter shaft with necessary shafting and pulleys for speeds from 1,800 to 2,400 R. P. M. Eight or ten-inch wire brushes are mounted. A fine emery stone for grinding can be applied on one end of the

spindle unless an additional grinding stand is supplied.

Buffers, Flexible.—Flexible shafting for operating small brushes while buffing inside of large tires. Essential in large shops.

Compressors or Air Pumps.—Can be secured in one or two cylinder types with belt drive to motor, and water or air cooled. Used to supply air to the mould

Figure 121.—Retread kettle, eight tire capacity.

bench for air bag use, for testing tubes, and for general service. Portable electric pumps can be used or automatic starting electric pumps can be used. These require little attention. Air tank and piping should also be supplied. Should carry 120 pounds or more of air.

Testing Tank.—For general shop use in testing tubes or for cooling purposes. Made either flat or upright. Flat size is about ten to twelve inches

deep with a diameter of forty inches. Connected to drain and with faucet facilities for filling.

Tire Roller.—Used for rolling and uniting sectional repairs, retreads, etc., either under pressure of spring tension or bolts.

Pressure Gauge.—For indicating steam pressure on line and boiler.

Figure 122.—Retread kettle, eight tire capacity.

Thermometer.—For indicating the temperature or heat of steam in line. Should be used as a check on the pressure gauge.

Force Feed Systems.—A gasoline tank with pump attachment for inflating to an air pressure of about ten pounds. To force gasoline to burners, mostly on coil boilers. Carries an air gauge and control valves.

Three or four gallons of gasoline is added, and the tank is placed outside.

Blocks and Cores.—Used in curing tread patches on various size tires. Is used on flat plates with clamp pressure. Metal blocks are grooved to fit the tire with a metal form to apply pressure from the top. Saves air bags. Set up in the mould.

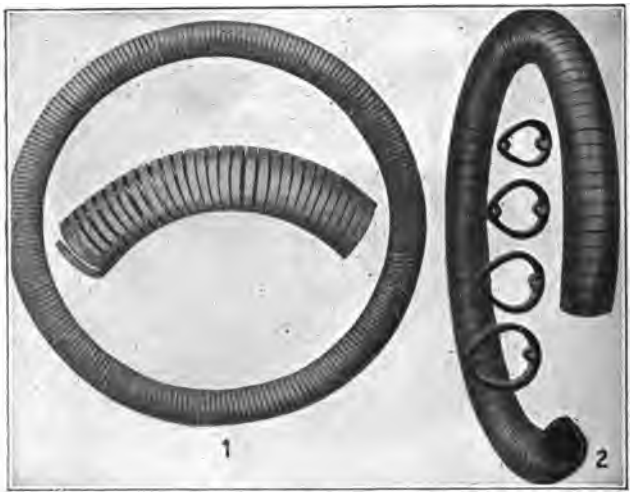


Figure 123.—Retreading coils. 1—endless spring coil. 2—segment core type.

Rotary Rasp.—A circular rasp used on the buffer spindle for tearing old treads from tires. Useful in general shop work.

Motor.—Used in operating the pump and buffer. For good speed and power a 2 H.P. motor for buffer use alone will be sufficient. When a pump is operated

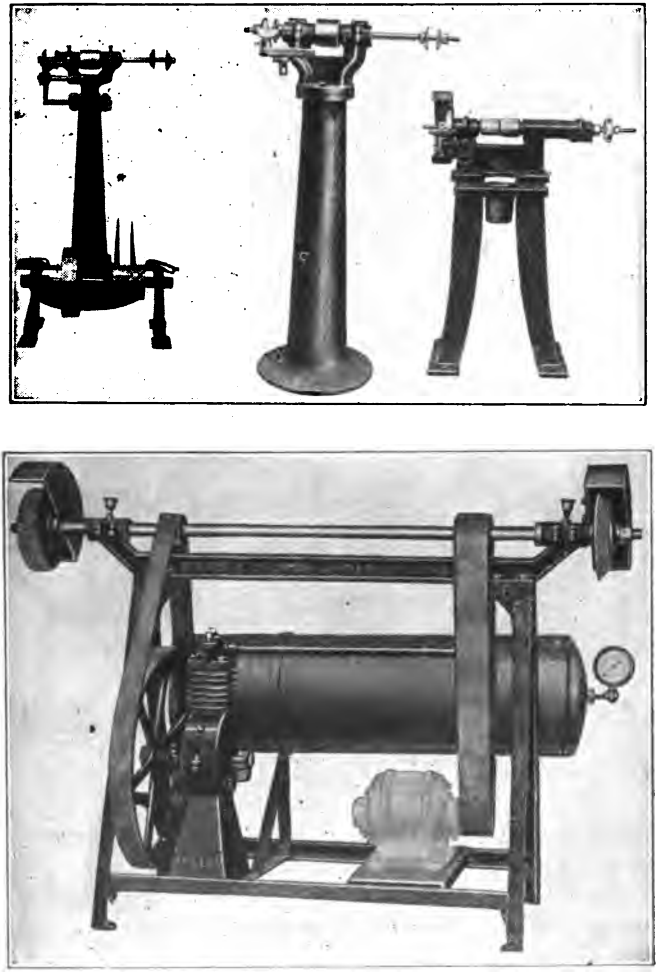


Figure 124.—Buffing stands. Combination type shown below.

at the same time with an additional grinder, a 3 to 3½ H.P. motor should be used. The motor should be ordered either for D.C. or A.C. current.

Steam Trap.—Is a mechanical device used on non-return steam systems to allow the escape of condensation (water) from the steam pipe. When the trap fills with water, it automatically empties itself without loss of steam. It will force water twice as

Figure 125.—1—bead moulds. 2—reducing shell. 3—rubber blocks. 4—gas controller. 5—bead spacer. 6—thermometer. 7—blocks and cores. 8—steam trap. 9—pressure valve. 10—regulating valve. 11—rubber mallet. 12—wood forms.

many feet upward as the number of pounds pressure in the line. Made in different styles.

Pressure Regulating Valves.—Used on non-return steam systems to reduce the steam pressure on the line below that in the boiler. Saves fuel and attention to the plant by allowing higher steam pressure

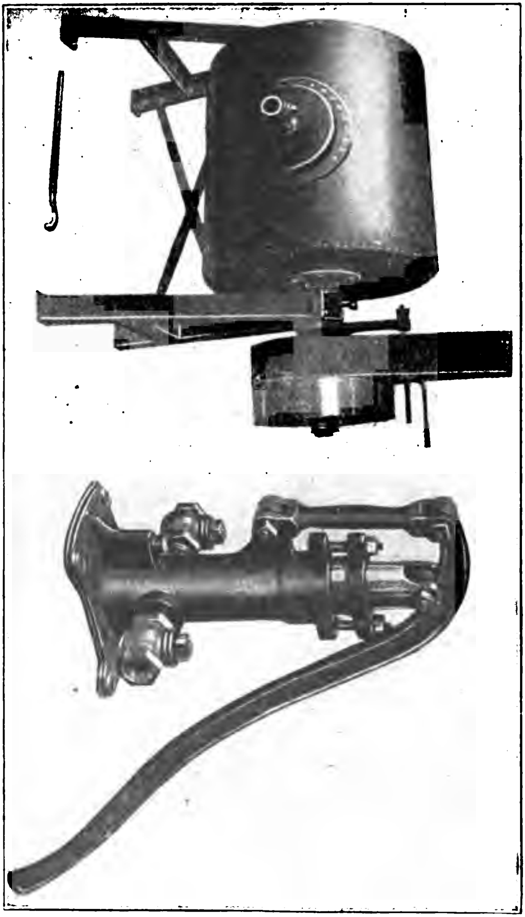


Figure 126.—Left—cement mixing machine. Right—water force feed pump.

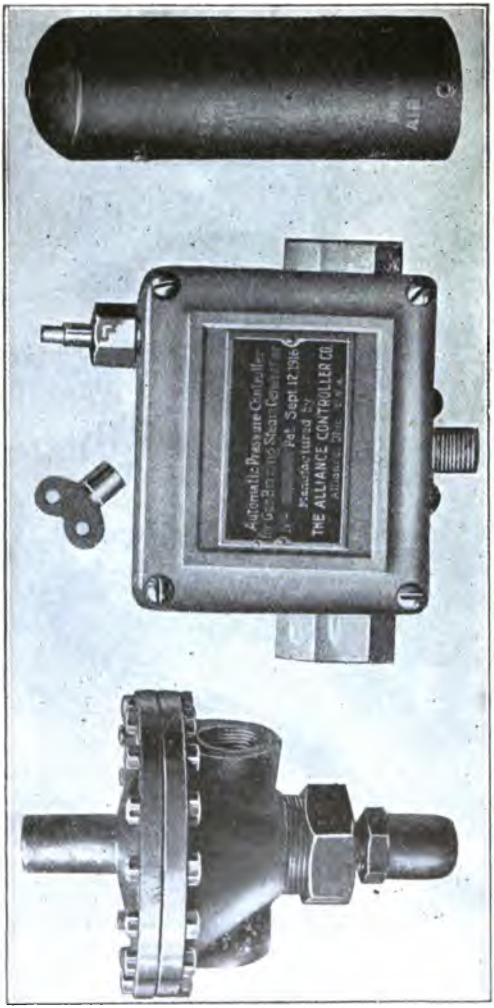


Figure 127.—Gas controllers and air tank.

on the boiler. Can be secured to reduce pressure as low as required. Made in sizes both in spring wheel adjustment or weight adjustment. Steam can be carried from a high pressure boiler for a distance and reduced to the required pressure.

Gas Controller.—A valve device for use on gas burners, and connected to the steam line or boiler by a pipe. Automatically shuts off the gas when a certain pressure has been attained, opening again as the pressure goes down.

Force Feed Pumps.—A hand operated pump used

Figure 128.—Building mandrels.

to force water into small coil boilers against steam pressure when city pressure or injector is not used.

Building Mandrels.—Steel cores made in various sizes, either stationary or disappearing. Used to place tires on when building up.

Splicing Mandrels.—Made in sizes for use in splicing inner tubes. Consist of a male and female metal frame in sets.

Tube Deflators.—A hand winding device on which an inner tube is placed, rolling over a double spindle,

which, after removing the core or depressing it, forces the remaining air from the tube.

Wrapping Machine.—Made in wall or floor types. Belt power driven for wrapping and applying pressure to retreads in all sizes.

Spool Winders.—Used for rewinding wrapping cloths on metal spools for use on wrapping machine. Belt operated.

Cement Tubs.—Belt operated for slow mixing of vulcanizing cements.

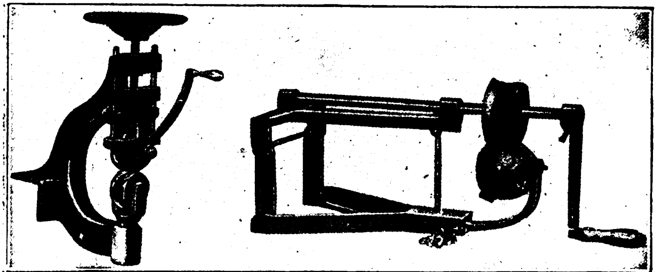


Figure 129.—Tread rollers.

Steam Tables or Presses.—Used for flat vulcanizing work with heat applied from one or both sides of the press. Manufacturing of rubber specialties can be handled.

Skiving Machine.—Used for skiving or feather-edging of blow-out patches, reliners, etc.; for general shop work. Hand operated. Also power operated.

Bead Cutting Machine.—Hand operated. Consists of two circular knives which cut away and remove old beads when making reliners, blow-out patches, etc.

Tire Spreader.—Special device with stand for

Figure 130.—Wrapping machines; floor type at left, wall type at right.

spreading tires during inspection. Operated by foot pressure.

Tire Changing Machine.—Special hand operated machine for removing tires from rims.

Check Valve.—Used in water, steam, air and gas lines to allow flow in one way only. Made in sizes.

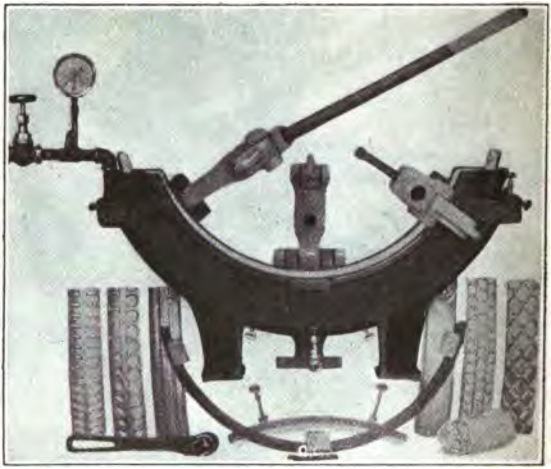


Figure 131.—Dry cure retreader.

SHOP REQUIREMENTS

In ordering equipment, everything depends on the size tires that are to be repaired, the repairs to be made, and the volume of work to be done. For garages, small shops, etc., in territory where only a limited number of cars are used, gasoline burner or coil boiler plants are practical. Where several men are to be employed and retreading and rebuilding

done, it will be necessary to equip with a larger plant, including a kettle and in most cases a large boiler. A shop can be started with small equipment, and developed to meet requirements as the trade increases.

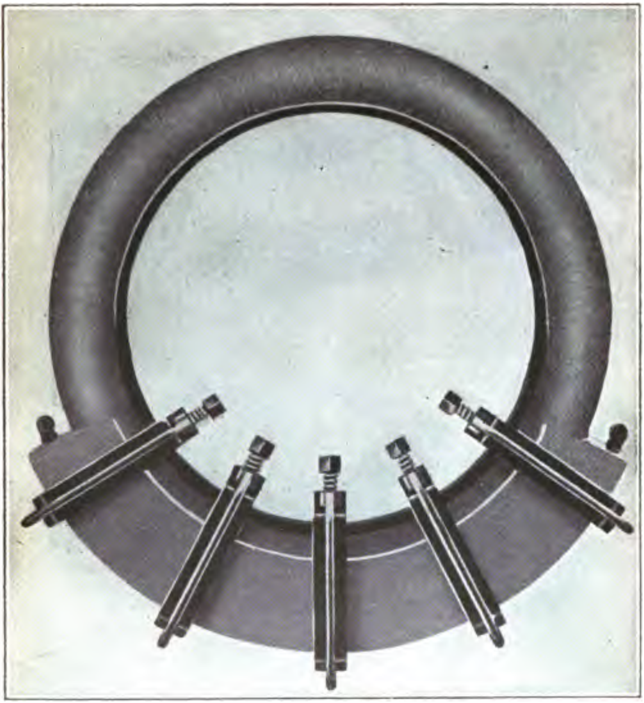


Figure 132.—Dry cure retreader.

There is, however, certain equipment that is essential for any shop. In selecting equipment, the sizing of the moulds or arms will in all cases denote the

number of moulds required to handle the range of tire sizes, the number being less should the reducing shell be used either for this purpose or for increasing the capacity in certain sizes. This can readily be seen in curing tires in sizes from two and one-half to five inches.

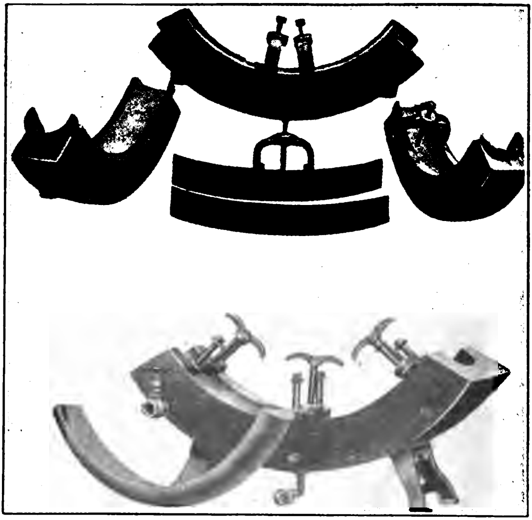


Figure 133.—Dry cure retreaders.

MOULD REQUIREMENTS

Measurement	Moulds Used	Total Moulds Required
¼″ size	(2-2½) (3-3½) (4-4½) (5-5½)	4
Even or ½″ size	(3) (3½) (4) (4½) (5)	5
¾″ size	(2½-3) (3½-4) (4½-5)	3

The larger sizes can be reduced with shells, necessitating fewer moulds in small plants. Some equip-

ments range only from three to five-inch tires with five moulds of single size in the block.

Figure 134.—Dry cure retreader.

It is also important to have an oversize mould to take care of the present five-inch tires, which are oversize, especially in cord construction. For larger

tires of the heavy duty type it is necessary to purchase individual moulds, and as greater capacity is required it is only necessary to secure more moulds with bead moulds in the required size, add a kettle, etc. At the same time, a boiler sufficient to handle the load is used.

Figure 135.—Curing arrangement for small shop using coil boiler plant.

The following list is for complete equipment of an average shop. Additions can be easily made. The important equipment is shown.

Moulds.—Sufficient to cure from two and one-half or three to five and one-half-inch tires, with or without shell. They may be single for use with gasoline burner, on a steam line to boiler, or en-bloc for the same use.

Boiler.—If using a full shop set and kettle, a boiler should be secured either of the coil type or larger flue type. It should have the necessary gauges and fittings.

Shell.—The shell is used for reducing the number of moulds required and still allow handling the tire range, or for doubling the capacity in one or two sizes.

Tube Plate.—Can be secured in four, six, or eight clamp capacity.

Inside Arm.—Should be provided to cure same sizes as moulds used. If using the inside arm or wrapped method, only a patch vulcanizer is used.

Figure 136.—Curing section and steam set up table arranged to be away from the building section.

Building Mandrel.—Should be provided in complete set or sets to handle the sizes of tires built up for cure.

Roller.—A hand power roller is really essential, although some shops do not use one.

Buffing Stand Complete.—Either a grinder head or complete buffer with base should be secured and equipped with an eight or ten inch wire brush, also a fine emery wheel. The buffer should be solid at the base and shafting.

Testing Tank.—Should be provided for tube testing and cooling purposes.

Air Pump.—Capable of pumping 150 pounds pressure.

Operated by belt attachment or electrically to supply air for shop use and for service.

***Air Tank.*—Should be of sufficient capacity to handle air service demand.**

***Motor.*—About 3 H.P., for running buffer and air pump, wired for current to be used.**

***Air Bags.*—To cure same sizes as tires being repaired.**

***Hand Clamp.*—For bead mould lock-up.**

***Vise.*—For general shop work.**

Should the plant be of the non-return system with high boiler pressure, reducing valves and steam traps are to be considered. In connection, such hand tools as are required should be provided so to take care of the various work.

The most essential tools are the following, which will take care of all shop work and service:

A twelve-inch flat file, a machinist hammer, combination pliers, Stillson pipe wrench, small cement brushes, large cement brushes, three-cornered six-inch file, plugging pliers, flat roller 2″x2″, a four-inch screwdriver, scissors, corrugated and smooth stitchers, valve tool, valve nut wrench, fabric awl, goggles, tread gauge, layback hooks, work hook, fabric knife, tread knife, rubber or trimming knife, carpenter's pinchers, rasp, rule, spreaders, sand or carborundum stone or stick, perforating awl, rubber mallet, straight edge, leather gloves, air gauges, jack, foot air pumps, tire tools and rim wrenches.

MATERIALS REQUIRED

The repairman away from the factory branch in a small town will require as large a stock as the city repairman, due to the fact that, in the city, the materials can be replaced as required, while in smaller towns it is necessary to keep a supply on hand at all

times for handling the work. The principal materials are shown below. These are used daily and to them should be added the necessary acid, boots, dust caps, valve caps, valve cores, flaps, gasoline, valve pads, blow-out patches, cementless patches, staples, soapstone, valves, and other parts in such quantities or sizes as will be used.

Tread Gums.—In colors, usually 1/16" thick; 15 to 25 pounds. If gum retreading is done, a large increase is needed.

Fabric.—Frictioned two sides, coated one side; 50 pounds.

Bareback.—Frictioned or coated one side; 25 pounds.

Bead Cover.—Frictioned two sides; 10 pounds.

Breaker.—Frictioned two sides; or frictioned two, coated two; 10 pounds. Increased when retreading is handled.

Cushion Gum.—In 1/32" thickness; 10 to 20 pounds.

Tube Filler Gum.—10 pounds.

Tube Backing Gum.—15 pounds.

Cement, Vulcanizing.—5 to 10 gallons.

Cement, Patching or Air Drying.—1 gallon.

Cords.—For cord tire repair (cable); small quantity of each size i and o.

Cord Fabric.—For use on cord fabric tires of each kind; 25 pounds.

Reliners.—In sizes used.

Retread Band.—In sizes used.

The vulcanizer will in a short time be able to gauge the quantity of materials required monthly.

BENCHES, RACKS AND TABLES

All benches, racks and tables are usually made in the shop to meet the conditions of the work being done. Many different kinds are found useful in a large shop. They should be made strong and of neat appearance and should be painted to improve the appearance of the work room if open for the inspection of the customer. The following is a list of the vari-

ous uses to which they are put, showing practical measurements to be used. For the smaller shop they can, in many cases, be combined and only such used as will handle the amount of work coming in. Items marked with asterisk (*) are essential.

**Cutting Bench*.—Built 2¾ feet wide, with a stationary work shelf 11x11 inches for upright work. In some cases, pipes are inserted in the side of the bench for this work. The correct height from the floor to the top of the bench

Figure 137.—Cutting and building positions to accommodate a large shop.

is approximately 37 inches. The bench can be continued in length with four foot intervals between the brackets to accommodate as many positions as there are men working. A shelf is placed below.

**Building Bench*.—Built 2 feet wide with a stationary work shelf on which the mandrel bracket is secured. Made 36 inches in height, and of length for as many positions as there are men working. A shelf is placed below.

**Tube Bench*.—Built 2½ feet wide, with removable shelf

about 12 inches long and 5 to 6 inches wide for working on tube repairs. Height to be approximately 37 inches from floor.

**Steam Bench.*—Four feet wide, 34 inches high from the floor. In this are inserted 1½ pipes 8 inches apart and close to the top of the bench for set-up work on tires. Put a shelf below.

**Equipment Bench.*—To hold moulds of the regular type. Built 2½ feet wide and about fifteen inches high to allow for getting tires down in mould and for a drain pipe below. On large moulds the moulds are set low.

Arm Bench.—The arm bench is built 2 feet wide, 18 inches in height and of a length to handle the number of arms used at intervals of 3½ feet. It may also be set up on a base 3 feet square with arms set on each side, thus taking 4 inside arms.

Bead Mould Rack or Table.—Can be made 3 feet wide, or, if only a few bead moulds are in use, 1½ feet wide and about 40 inches high. On this table all bead moulds should be placed as soon as removed from the set-up. Never leave bead moulds lying around to be chipped or broken by being dropped on the floor. Space below this table can be utilized for tires while awaiting the cure.

Inspection Bench.—For the inspection of all tires brought in for repair, and used in connection with service and entry bench. Built 4 feet long, 1½ feet wide, and about 30½ inches high, with a back attached against which to lay tires.

Entry Bench.—For entry of all incoming work in the service book and for tagging. Made 2 to 3 feet wide, 41 inches high for stand-up use, and of a length to accommodate the shop.

Stock Cabinet.—Built for holding rolls of gum and fabrics. Should have a double door, and be two feet wide, five feet high, and four and one-half feet long, with ledges for rolling piping to fit and hold the rolls. The sheeting of this cabinet with thin metal will make it proof against moisture, etc.

**Work Bench.*—Made 3 feet wide, 34 inches high, and of required length. Used for heavy work and vise use. Found in many shops.

**Stock and Cutting Bench.*—Made 4 feet wide, 34 inches

high, and of good length for cutting all fabrics and gums. Placed in front of the building benches. A stock rack with 1 inch piping is placed at one end, on which rolls of materials are placed and pulled over the bench for cutting.

**Testing Tank Bench.*—Built to fit testing tank at base; 25 inches high when tank 1 foot deep is used.

Storage Bins.—Of any size for keeping all scrap fabric, peelings, sweepings, etc., from accumulating in piles about the shop. Covers can be provided.

Tool Boxes.—Made 15 inches long, 4 inches deep, and 8 inches wide. A box should be provided at each position for tools not in use. They can be turned into stock room daily if necessary.

**Tire Racks.*—Usually 2½ feet wide and of sufficient height to clear the largest tire. These can be made or purchased from manufacturers.

**Hangers.*—Should be provided for the drying cemented tires in the cutting-down room and for tube drying at the tube position.

The arrangement of all benches in relation to the equipment and buffers should be such that work of a nature that will raise dust is kept away from the cemented tires and the building room. If possible, the work should be done in buffing, cutting, building, and curing positions, and each should be separate from the other. This will be found to facilitate and systematize the work, and at the same time will protect the cemented tires and new gums from dust from the buffer or from the steam bench. Keep a floor space for set-up and changing of tires.

Provision should be made for covering all installations of the air supply, the gas supply if used, the water supply, electric wiring, and the shafting and pulleys from the motor to buffer and pump.

CHAPTER X

SERVICE AND RIMS

Taking everything into consideration, the repairman or seller of tires only delivers satisfaction, measured in miles obtained, or service given in a rapid and workmanlike way. Good repairs speak for themselves in the cost per mile secured. However, good repairmen have failed in operating a shop by not delivering service to the tire owner in the proper manner.

An owner is always impressed by a quick and courteous manner and by receiving information that will be of value to him when it is necessary to make tire changes or to take care of his tires to secure the most mileage. Either at the shop or on the road, this service should be above reproach, and no hesitancy should be shown in explaining to the owner that the same abuses that injure his tire will injure the repair also.

It is not to be expected that service can be given away unless a fair return is forthcoming in the way of greater business or in a direct return for the service when performed. The owner will be glad to pay for service at or away from the shop, provided you deliver satisfaction with it.

The service-man, who is at all times dealing with the public, is of far greater importance to a growing

shop than any other employee, as it is through him that the work is secured and held. In his daily work new customers are obtained and tires requiring repairs are brought before the owner in such a manner as to denote an entire knowledge of the tire business. In a large shop, a good service-man, attending strictly to his work, can obtain a double amount of repair-work and new business. Such a man is always looked for by the exacting customer who knows he can depend on the information given. A poor service-man will loose more customers than good work can bring in.

The manner in which the service-man handles his work is the first thing noted, and his knowledge of the business is next. He should know tires, both for sales and repairs; he should know the various kinds of rims, the cost of repair work and the time required to get it out. He should understand injuries and defects, tire accessories, the dismounting and setting up of tires and tubes. Remember that advertising is done to bring the company before the customers. When you have the customer at your door and do not satisfy him, it is your loss. Under those conditions advertising will never be of value.

The service-man at the shop should remove all tires on rims from the car on the street. In order to hold trade, the owner should not be expected to do this. The tire should be dismounted and the tube removed for inspection. The tube may be flat, and the casing may need repairs, and an estimate of cost should not be made until after the inspection. The tube should be tested, and if holes are found toward the center of the tube nearest the tread, the casing should be in-

spected for a small nail, tack, piece of glass, or small break. The work required can then be shown and the cost and time estimated. Tube repairs can ordinarily be made in thirty minutes or less. Sectional work usually takes two days, and retreads and rebuilds about four days. This time can be shortened, but as a general rule will be found close except for rush service. The time once given, the work should be ready, and if extra work is required the owner should, if possible, be notified by phone either of the delay or extra charges.

The reason for the injury should always be explained to the owner in order to avoid the same injury to the repair when made and placed on the car. If underinflation or overloading has been the trouble, the inflation tables which are recommended for general use should be explained.

For systematic work in a large shop the service-man should have designated racks or hooks for:

Rims held for set-up.
Casings held for set-up, tube being repaired.
Tubes being held for set-up, casing being repaired.

In doing this when a casing on the rim comes in, it is dismounted and the case and tube, being for repair, are tagged. It is a simple matter to mark the case tag numbers on the tube tags and *vice versa*, and to mark both tag numbers on the dummy tag on the rim. By doing this, you will never mix tires of the same kind and size which come in on the same day from one owner. As the work is completed, the complete set-up is automatically assembled and should be immediately set up, inflated, and placed in the out-

going rack for delivery or for the owner when calling. Never allow a set-up to lie around until it is called for.

INFLATION.

Inflate fabric tires to 20 pounds to the cross-section inch. Thus, a 4 inch tire, 80 pounds.

Inflate cord tires to 17 to 18 pounds to the cross-section inch. Thus, a 4 inch tire, 70 pounds.

Inflate aeroplane tires to 15 pounds to the cross-section inch. Thus, a 4 inch tire, 60 pounds.

Regular sizes built to an oversize should carry the oversize inflation, which is usually marked on the side of the casing.

The above rules will be found to work satisfactorily on all inflation, giving good riding body to the tire and bringing it up to a direct center on the road. Air carries the load, and the tube acts as a blanket in the case, which is only a casing or wearing covering for the inflated tube. The more the tire is brought up to a center, the less surface is exposed to the road, therefore less friction is created and less wearing surface is exposed. When under-inflated, from two to three inches of tread surface is in contact with the ground or road pull. It is this road pull, combined with the tendency of the carcass to bend inwardly towards the rim, that causes loose treads, separated fabric, and if too pronounced, broken side walls and rim cuts.

After inflation, all tires should be tested with the air gauge or tire caliper and never estimated by kicking the tire or by looking to see if it is up to a center. It is very easy to over-inflate a tire and that is unnecessary. Again, the tire may be holding to cen-

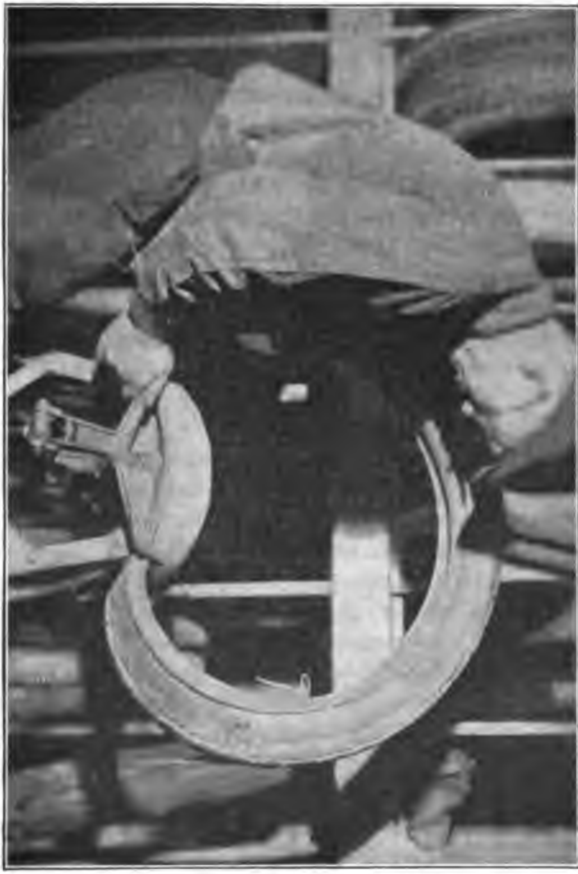


Figure 138.—Inspecting tires.

ter with the empty car, yet it may be just at the point of giving under the car itself, so that when loaded and running it will drop to a point of underinflation as soon as load and pull are applied.

A perfectly inflated tire will have less tendency to pick up nails and glass and it will also resist the impact of a bruise more readily when striking a stone or other obstruction. It is the quick bending action that causes rupture to the tire and the less air resistance there is, the quicker it will break.

The number of pounds weight to be carried per wheel should be determined by the maker of the tire, as tires have more or less plies per size and the core, or air capacity, may be larger or smaller.

Many owners object to carrying tires inflated to capacity, especially if they have been in use for some time. This is on the theory that on warm or hot days the pressure increases from running. This, to a limited degree, is correct, but the increase is only about two pounds to the square inch. The abuse from underinflation is two-fold that which might result from the slight increase, because the greater tread surface exposed causes more friction and therefore more heat, resulting in a broken down tire for which there is no excuse. Furthermore, the success of a well placed repair depends on the inflation being up, as jar at the end of the repair is thereby eliminated. On underinflated tires the end of the repair receives a kick on very revolution and gradually loosens and blows out the job. The largest percentage of repairs which fail are due to this cause, as the repaired section is stronger and stiffer than the rest of the tire and naturally resists the bend. Tread patches are kicked

out in the same manner and splices are opened up.

Repairmen should advise car owners that, due to these conditions, air pressure should be kept up. The impression that high air pressure is due to heat is not correct, as a tire with eighty pounds of air on a hot day, say at eighty degrees, will only increase approximately five per cent, or from four to five pounds. Therefore, if the air is kept up to seventy-five or eighty pounds, it is not going to injure the tire or cause greater bruises. Expansion in tires is due to the friction of the tire and the less air carried, the greater the friction. Therefore, the greater increase in pressure is not due to weather conditions, but to the friction.

Air will not remain in tires forever, and therefore they should be tested and inflated weekly for best results. The valve core may leak very slowly or the valve nut become slightly loose from the setting of the rubber tube under the washer when in use. These things will allow loss of air down to a certain pressure.

RIMS

During the work of making changes and in set-up, many different kinds of rims are encountered and these should be fully understood as to the easiest and quickest methods in removing or setting them up. Special tire removing machines are available and these will save much hard labor when tires are frozen to the rims. However, the workman with proper hand tools can quickly remove most tires. A good service-man will do all tire changing on his feet, as it is unnecessary to putter around with the work on the floor on every tire set-up.

There are many makes of rims, with new rims always being made and applied as car equipment; however, these are all presumably built to a standard to take the tire bead types in use which are as follows:

Regular Clincher.—Made in an endless or solid type, and also in split rim types for soft bead clincher tires. The rim is usually a part of the wheel, but may be demountable. The tire is forced on and comes back under the bead channel when in place.

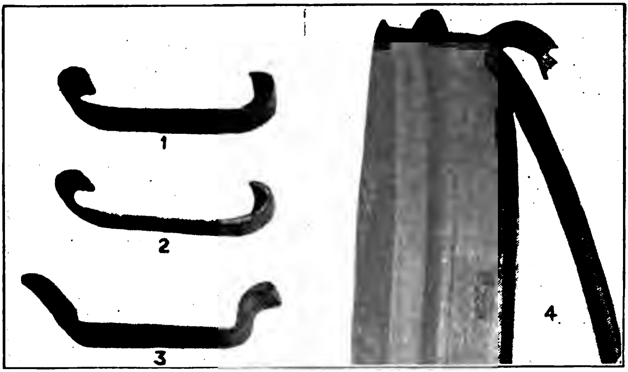


Figure 139.—Types of rims. 1—regular clincher. 2—quick detachable. 3—straight side. 4—universal.

Quick Detachable Clincher.—For use with Q. D. tires with hard beads or cable Q. D. beads. In this type a removable side or split rim is used so that the tire can be placed on the rim and worked around, or placed over the rim entirely, as in the flange type, and then the flange applied.

Straight Side.—For use with S. S. tires. Similar to the Q. D. as to the use of split rim and removable side flanges.

Universal.—Used for mounting both straight side and Q. D. clincher tires. The removable side flange only is used. Two interchangeable bead rings are provided, which reverse for the type of tire mounted.

Many rim manufacturers have had their rims standardized to agree with exact measurements. These rims are stamped, and the standard stamp is in many cases referred to by the tire manufacturer in specifying the mileage guarantee.

When the tire is clear of the rim, stand it up. Never work on a tire while on the knees or while sitting down either in removing or replacing the tube. Should the tire have a flap, remove it by pressing on the top of the tire, when, by bending over, the flap draws out easily. The tube is then removed with care in all cases, as it might be frozen or stuck to the casing. Pulling too hard might tear a tube to such an extent that it could not be repaired. If a tube is frozen, work the fingers and hand down the side of the tube until it comes away easily. Then, by pulling carefully endwise, this danger is eliminated.

Some of the rims most used and encountered by the repairman are listed below, and the method of removing the tire is described. The method of changing tires is optional with the repairman. Every workman, through practice, devises a method by which the tire can be removed in the quickest manner. The descriptions given will start the tire changer on the right path for simplest removal. The tools required, when the work is done by hand, are a heavy machinist hammer, two ten-inch screw-drivers, a tire tool, and a pair of pliers. With these, almost every tire can be dismounted or replaced in an easy way. Always let the air out of the tire. Never pound a rim or lay it on the floor in cases where it is necessary to loosen a part. Nearly all rims are removed standing.

Baker (*Light Rim*).—Made in split, straight side, and

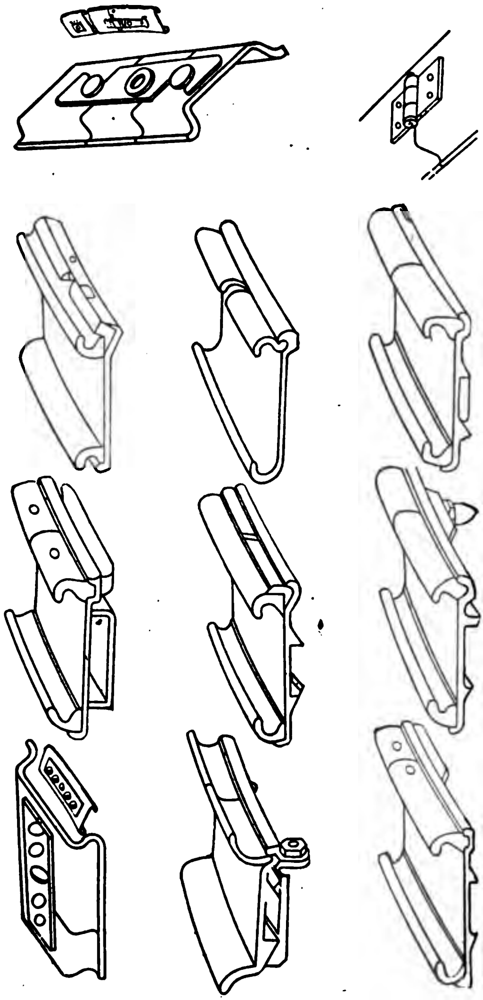


Figure 140.—Kinds of rims. Upper row, left to right—Baker split straight side; Booth removable side flange; Firestone removable side flange with lock ring; Detroit connection for split rim; Perlman. Second row, left to right—Goodyear spring side flange; Goodyear removable side flange with lock ring; Houk spring side flange. Third row, left to right—Kelsey spring removable side flange; Standard spring, removable side flange.

quick detachable types, with a plate setting over four lugs, two on each side of the valve hole. Remove by first inserting the screw-driver under the plate and driving lightly with hammer, which removes the plate. Insert the tire tool down under the tire bead and against the short end of the diagonal split, which is opposite the valve. Drive the tool until tight. Tap the opposite side of the rim with a hammer and at the same time press down on the tire tool, which will slide and force the end of the rim clear of the tire. After this, the rim is worked away from the tire.

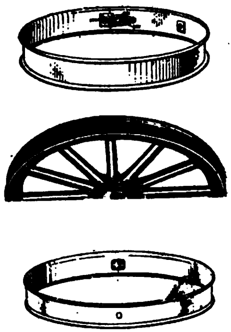


Figure 141.—Kinds of rims. Top—Stanweld split rim. Center—solid clincher. Bottom—Kelsey split rim.

Booth.—This rim uses a split side flange fastened with a special holder or clamp. The flange holder is removed and the screw-driver tapped between the rim and flange until one end comes up over the rim, this end being then worked from the rim. Replaced in a similar manner.

Continental.—Run in two halves, having lips about every one and one-half inches to fit over corresponding grooves. The rim half is tapped around to clear the lips.

Firestone.—This rim is a removable side flange type, with a solid ring and a split lock ring. One end of the lock ring is forced out of the rim channel and is worked out. The ring is now removed, then the tire. To replace, place the tire, apply the ring, and start one end of the lock ring. Start usually with the small lug in place, and, while stand-

ing on the tire on the floor, tap slowly into place by holding behind the hammer with a pair of pliers.

Goodyear.—This is a spring flange type removed by forcing one end of the flange over the rim and working out. Replaced by a similar method. The Goodyear removable side flange type, with ring and lock ring, is removed and applied like the Firestone.

Houk.—This is a light rim with a spring side flange and is removed the same as Goodyear side flange.

Perlman.—This is a split rim with a special lever which is tapped open. The end of the rim with a slot for the lip is then forced out under the tire and worked out. For replacement; the end with the lip must be set on first and the other end forced over to fall into place, after which the lever is tapped into place. Care should be taken to see that the lever slides under the lip.

Detroit.—This is a double split rim with a removable section about four inches long. This special section fits into the gap with a double lever turning on rivet. The lever is tapped away from the hooks and the piece removed. The end of the rim is pushed under the tire and worked out. The tire is applied in a similar manner, care being taken to start the rim at one end so that the valve will enter the valve hole in the section.

Kelsey.—This is a spring removable side flange type with special flange holder. The rim is removed like the Booth. In the split rim, a hinge with a small pin or iron is the locking device. Remove the pin and start the rim under the tire, taking care to start the end that will clear. To set up, pull one end up on the other and start the tire with the valve at the opposite side. As the tire is forced or tapped on, the rim will spring in place under the tire and will then fall into the hinge, when the pin is inserted. Another type of Kelsey rim is a split type with a double short lip for a locking device. A screw-driver is inserted into the lip and the rim pried apart to allow the under lips to clear, after which the end is forced under the tire and worked out. The rim is overlapped for replacement.

Stanweld.—This rim is similar to the Perlman, except that the lip is on the outside. Start the screw-driver under the lip by tapping slightly, which will allow for throwing the rim end under the tire and working out. Replace by starting one end with valve set and working on, after which

a tire iron is set under the tire and the rim tapped back into place as the iron is pressed downward.

Solid Clincher.—This type of wheel is made by most all rim companies.

Should rims be too large for the tire, which happens on some cured tires, due to shrinkage, two blocks set inside the rim, usually 4″x4″x14″, and a jack applied, will force the rim into place.

All rims should be buffed free from rust and scale and should be treated with a graphite rim paint at least twice a year. This will stop freezing of the tire to rim. A frozen tire requires the working from the rim by the use of two tire tools, working in small sections until completely around the rim to the valve. This operation must be repeated several times before the tire is free to clear the rim, especially on side flang types. No rim should be set up with lugs out, as this will blow out the tube. A flap may cover the hole, but the lug should be replaced. Bent rims should be repaired and all locking devices put in good order.

All tires, tubes and rims should be properly tagged for identification when dismounted. The tag shows the work to be done, when completed, and the charges.

In setting up the tire, all sand, old soapstone, talc and mica should be cleaned out and no tacks or breaks left to pinch the tube. New talc or mica is lightly dusted or sifted into the case to prevent sticking and friction. The tube is slightly inflated and inserted in the case. A flap is placed to cover the tube and fit down both side walls without pinching the tube. The whole is then applied to the rim as before explained. The flap should be used on all casings except the clincher types on solid rims. On

wire wheels of the airplane type, the clincher tire usually has cemented-in flaps. However, should no flap be found, a band of fabric can be applied around the wire wheel and cemented to protect the tube from the spoke ends. Inflate to proper pressure and test.

Care should be taken that the beads fit properly into the rim channel and that the flap remains evenly in the case without slipping out under the rim when applying the casing. The mounted rim is then applied on the car wheel, using care to tighten the rim lugs evenly so that there will be no sliding or shifting on the wheel. This would break off the valve in the tube when running. Place the valve cap and the rim nut to hold tube in place, also the dust cap.

ROAD SERVICE

When operating service cars for pick-up and general service, it is important that the man doing this work should be prepared to take care of all conditions likely to arise when away from the shop. A complete set of service tools should always be in the car, together with a road service kit containing tube repair materials and tools either for vulcanizing or patch work. Boots, extra tube, and for safety, an extra casing, old or new, of the same size as used by the customers, should be included. When the request for service is made, the size on the customer's own tire can be learned.

Special air tanks or pumps can be installed on the service car if the call for service is great. With these, sufficient pressure should always be obtainable. See that no oil is used in the air. Test a hand pump before starting to see that it is in working order.

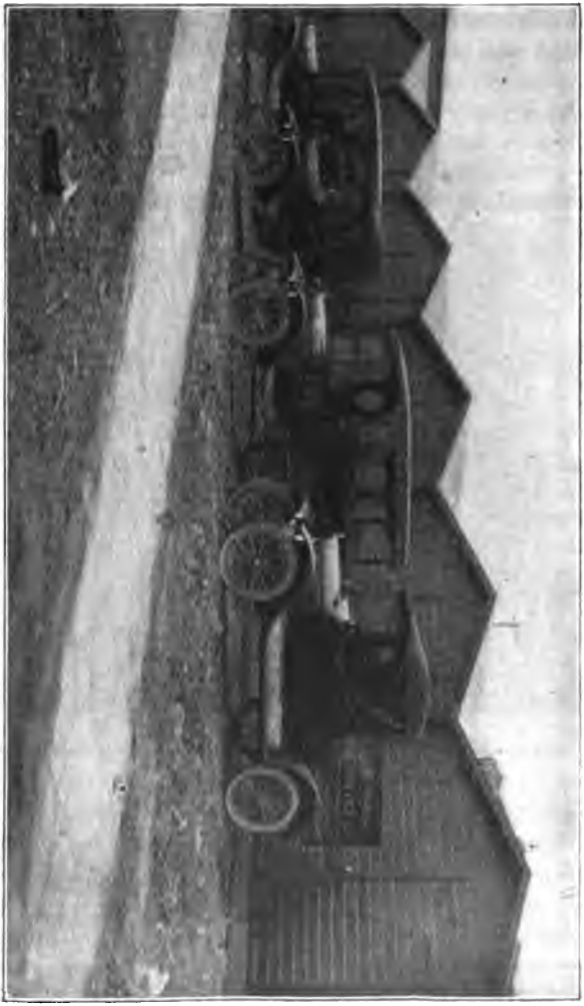


Figure 142.—Types of service cars.

Should the jack not work, it is possible to block up a wheel and dig out the ground from under the tire, thus allowing removal.

The experienced road service man will always bring back either a tube or casing for repair, as this is a nucleus for future business. It is not usually practical or profitable to make tube repairs on the

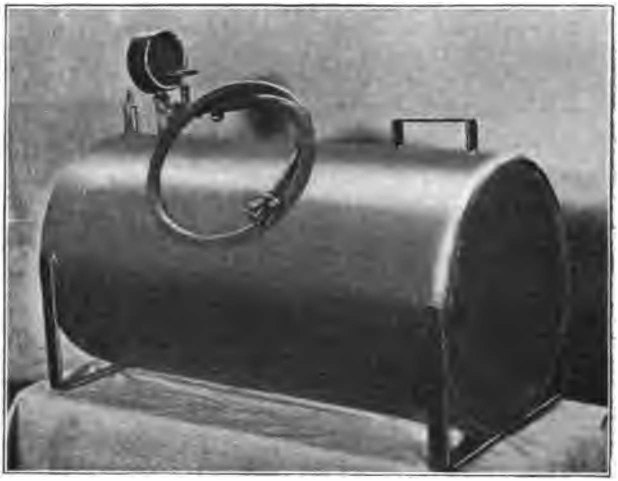


Figure 143.—Portable air tank for two hundred pounds pressure.

road. If possible, a new tube, as well as a new casing, should be sold if the customer does not have the extra casing which he should carry for his own protection. When the tube is brought into the shop, it is immediately repaired and made ready to go out again if the customer should have more road trouble or should he call for it. The tube should be properly

repaired and vulcanized, not repaired with cold patches. If a customer once puts a blow-out patch in his casing, he forgets about it, while had the proper repair been made in the first place he would have been money ahead.

Tires should be inspected by a reliable tire man at intervals. It will save money. Have any and all cuts repaired, as the cuts injure the tire, allowing entrance of water, oil and dirt.

INFORMATION FOR THE TIRE OWNER

The customer should be advised how to care for himself when alone and also when not using the car. The floor of the private or public garage should be kept clean of oil and chemicals, which soften tires with which they come in contact. Such things should be wiped from the tires with gasoline as soon as seen. When the car is to be out of service for a long time, the wheels should be blocked up and only sufficient air left in the tires to give them body, or the tires may be removed, the tubes slightly inflated and laid down the same as the casing. Should any breaks be found in the tires, they should be sent out for repair so to be ready when needed. The tires or tubes, covered, should be kept in dark, cool places and away from dampness. For the best results, storage should be in a temperature of about forty to fifty degrees. Cold sheds and garages or hot attics should never be used. Light, heat or dampness will ruin rubber of any kind by taking the life out of it. Use a tire cover on the spare tire.

The test of a tire on any particular wheel is not fair to a good tire. This is shown by the way in

which a driver will protect the front tire on the driving side, in all cases throwing the abuse on the other wheels. Whenever the tires are removed, better service will be obtained by reversing and placing the worn side in. The greater strain comes on the outside, towards which the weight of the car is added while turning. The outside receives damage from ruts, as there the wear is mostly on the outside.

Never use undersize tires in the front and oversize tires on the rear in rutty country, as greater wear will then come on the rear tires. The front tires should be changed to the rear after a period of service, as the greater strain comes on the rear wheels. Never run a tire, except for temporary use, with a blow-out patch to cover a small break, as the road pull will gradually increase the small break until a large blow-out is the result. Loose fabric also appears from the friction caused by the patch.

If a tire is punctured, stop immediately. Riding on the flat tire is grinding dollars out of the case and also ruining the tube, which was not made to resist the weight of the car. The weight pinches the tube between the sides of the creased tires on the rim flange. It may be weeks before the effects show up on the tire, even though it appears uninjured on the outside and perhaps on the inside. The crease has been made in the case, and movement of the tire gradually breaks open the side wall.

Stone bruises act in the same manner. After hitting an obstruction hard and sharp, the tire should be examined at the earliest opportunity, when a soft spot will be found in the case. This should be repaired immediately, as running will develop a pinched

tube and blow-out at some later date. It is due to such bruises that many tires are brought in for adjustment on which the owner feels sure that he has not had a stone bruise for weeks. However, the bruise could have been received weeks before and just broken out at a time when he may have been on good road or pavement for several days.

If a flat tire is encountered and no spare tire or tube is available, always remove the tire and, if necessary, drive in slowly on the rim. It is better, however, to wrap the rim with old rope or canvas, if procurable, to protect the rims from being bent at the flange. If the casing is an old one and cannot be repaired, remove the tube, replace the tire and run in on the old casing, which will protect the rim. When placing a tire after running on the rim, see that all mud and dirt is out of the rim channel.

The alignment of the wheels should be attended to at intervals. Misalignment may result from two causes; a bent spindle or axle, or a warped wheel. Either can be noticed immediately by jacking up the wheel and spinning it while holding a stick or tool for a gauge at a fixed point and watching to see if the tire is running true with the gauge. If it is misaligned, it will sway to and from the gauge in place of running evenly.

Poor brakes, misalignment and underinflation cause seventy-five per cent of tire trouble in mileage. These things are due to carelessness on the part of the car owners themselves. Eight out of ten owners do not understand these causes of abuse, which could be easily overcome with a little care and attention. Tire owners should remember that tires are only made of

cotton, frail at its best, and rubber and compounds. It is about as reasonable to expect adjustment of tires for the above abuses and bruises as it would be to expect a tailor to give you a new suit of clothes when you go out and tear them by carelessness.

Tubes should always be placed in a cloth bag or box when carried as extras, and should never be thrown unprotected in a tool box. Oil and grease are picked up and the shifting in the box will, in a short time, wear through and chafe the edges, or the tube is likely to be punctured. A tube should not be hung on a peg for a long time.

Tube fillers or anti-leaks are not recommended for use, being in most cases mixtures of water, asbestos, cement, ground cork, white lead, gum arabic, etc., which will, in large punctures, ooze out and into the casing, increasing friction and deteriorating the tubes in time. A good tube and casing, properly used, is best for satisfactory riding and service.

Many different substitutes are offered for the pneumatic tire. These include fillers, solid blocks, etc. However, it will be found that expense is saved and mileage gained by using the light pneumatic, because every pound placed on the wheel is equivalent to twenty on the frame. The added weight consumes more gasoline, and the wear and tear on the gears and brakes will be greater.

Special tire retread bands, half soles and reliners are available for application to the pneumatic tire, but when used should be vulcanized on the tire and not fastened with cements that depend on the inflation to keep them on. Studded tire treads are to be used with judgment and only when desiring to secure

service from old tires, as friction is found in all such articles.

The proper care of tires can be consolidated into four main rules. Failure to follow these rules constitutes abuse, and the resulting damage should not be laid to faulty workmanship or material on the part of the manufacturer. These are the proper rules:

Maintain the inflation pressure.

Use rims approved by the S. A. E.

Apply tires only on the corresponding type and size of rim.

Protect the tire against the known causes of abuse and injury.

The user should become thoroughly acquainted with ten rules of tire upkeep, which will give double the satisfaction and mileage to the pneumatic casing, and will save money and inconvenience when driving.

1. Buy good recognized casings and tubes, and do not use substitutes for air, resoles, or any articles that will create friction when running.

2. Inflate all tires from eighteen to twenty pounds to the cross-section inch, regardless of the weather.

3. Avoid quick starts, stops and skidding.

4. Use care in placing the tube and flap, and do not use too much soapstone.

5. Use chains only when necessary on dirt or muddy roads. Remove as soon as convenient.

6. Keep wheels in alignment at all times.

7. Acids, oil or grease should be immediately removed from tires by the use of gasoline and a cloth.

8. Use rim paint or shellac on rims to prevent rust-injury to the tube. Flap should be used at all times if possible.

9. Prevent damage to the tube and damage to the casing by avoiding obstructions on the road.

10. Have the tires inspected regularly for repair of all small cuts, sand blisters and small bruises. Their neglect will cause deterioration, large blowouts and loose treads in a short time.

CHAPTER XI

TUBES AND TUBE REPAIRING

No part of the vulcanizing trade receives as little attention as that of the proper care and repair of inner tubes. This is no doubt due to the fact that the work is easy and any repair is thought sufficient as long as it holds air, temporarily at least. This is wrong, as all the skill of the finished repairman should show on the kind of tube work he is capable of turning out as judged for strength, neatness and future protection to a valuable casing.

There is no excuse for bungled tube work in either holes, pads, or splices. When the tube leaves the shop it should be in condition to give long-lived service. A properly repaired hole in a tube should not blow out or leak at that place, even if inflated until it bursts. If a tube is in poor condition when brought in, do the same as with a tire; inspect it, and if beyond repair, or if only capable of short service, junk it so that it will not injure an expensive tire by going flat at the wrong time.

TUBE CONSTRUCTION

There are several methods of making inner tubes at the factory. They may be made from a regular rubber sheet, or from many thin rubber sheets for laminated tubes. They may be built on long, straight

mandrels or on circular mandrels to conform to the curvature of the tire. The rubber is washed and dried, mixed with the various compounds for red or grey tubes, and the rubber calendered in required layers of gum. The rubber sheet or layers should set for some

Figure 144.—Making tubes.

time to allow for shrinkage, which then will not continue after curing.

The sheet is cut into proper lengths and rolled around the steel mandrel, soapstoned, and wrapped with cloth, after which it is cross-wrapped under

heavy pressure to prevent sagging from the mandrel when cured. The tubes are then cured in a large heater with a door at one end. The cure is according to compounds, usually being about two hours at forty-

Figure 145.—Finishing and inspecting tubes.

five pounds. When cured, the tube is unwrapped and placed on the stripping table, where the steel mandrel and tube are separated by blowing with compressed air, which turns the tube inside out.

The ends of the tube are buffed and cement (acid or

quick-cure) is applied to the splice ends. The valve is placed inside the tube and the pad cemented on. If the cure method is used, it is placed in the heater for a short time, after which the valve is pushed through a hole in the valve base and tube, and the valve washer and valve nut applied. The tube is then inflated and tested, marked and packed.

In the acid-cure method, the same procedure is followed, except that acid-cure cement is applied and acid is brushed over the cement as the splice is made. The splice is wrapped with cloth for a short time while setting.

New tubes that tear easily are usually too heavily compounded or over-cured. In sizing tubes when made they do not have the capacity that the nominal size calls for, being built slightly smaller by some manufacturers, while others give only about sixty percent of the capacity of the tire. This is to allow placing the tube in the case without pinching, which would take place if tubes were made full capacity and allowed to come up to the bead line across the tire. It is for this reason that regular size tubes should not be used in oversize casings, being already undersize for the regular tire.

The tube is nothing more than a rubber container or blanket to prevent air from escaping. The strength for resisting inflation is in the carcass of the tire. Therefore, the tube must be smoothly encased in the tire and protected from breaks, nails and bead pinches.

Tubes are made in various thicknesses, and colors such as grey, black, red or combinations are available. A pure gum grey tube is elastic and capable of good service for cool and average weather conditions,

providing it is not too heavily compounded. The red tube is compounded with such compounds that toughen it and is used to a great extent in hot weather driving, being somewhat tougher and a better heat resistant than the grey tube, but not as elastic and pliable.

TUBE INJURY AND ABUSE

Tubes, like tires, can be injured or abused knowingly or unknowingly. The following is a list of injuries encountered daily in repair work.

INJURY OR ABUSE	REASON	REPAIR USED
Blowouts and Tears	Due to breaks in casing.	Large hole repair or splice.
Pinches	Running flat or from flap in improper set-up.	Hole repair.
Punctures	Nails, glass, small breaks.	Hole repair.
Run Flat	Without sufficient air.	Hole repair if possible.
Deterioration	Aged, too much lubricant, exposed to sunlight, etc.	Usually junked.
Valve Base Cracks	Running flat or soft.	Replace pad.
Broken Valve	Run flat or rim shifting.	Replace valve.
Leaky Splice	Run flat.	Resplice.
Chaffed	Tube too small in case, carried in tool box or by fillers.	Repair necessary.
Wrinkled or Creased	Tube too large in case.	Repair necessary.
Stretched	Heated running flat.	Repair necessary.
Splits or Tears	Inflated too heavily and cut on flat. Blow-out.	Large hole repair or splice.

TUBE DEFECTS AND ADJUSTMENTS

The defects in tubes are limited and most tube

Figure 146.—Tube abuse and injuries.

replacements are a matter of policy. The following are accepted when governed by conditions:

Leaky Splice	Due to improper workmanship.	Usually repaired or adjusted.
Damaged Splice	Due to improper workmanship.	Usually repaired or adjusted.
Substance in Tube	Due to mixing or calendering.	Adjustment.
Porous	Improper material or curing.	Adjustment.
Overcure	Brittle or hard. Not found in good tubes.	Adjustment.
Undercure	Soft and baggy. Not found in good tubes.	Adjustment.
Rotten	Heavy or poor compounds causing inside breaks. Not found in good tubes.	Adjustment.

Inside breaks in good tubes do not constitute a defect, but are caused by the tube lying in stock too long. The tube then sets and forms a crease in the fold along the edges. When inflated, the crease gradually opens up and develops a leak. Such a tube is not worth repairing, as it will keep breaking out at the end of the repair. Tubes should always be examined for fresh stock when buying.

TUBE REPAIRS

Tube work consists of repairing holes, tears, and blow-outs; placing new valve pads and valves, and making splices.

Tubes are repaired in the following ways by various repairmen or garages:

Everlock fabric (khaki back) with patching cement, or acid cure.

Everlock fabric (khaki back) with cementless patch.

Cementless patches.

Rubber patches with patching cement or acid cure.

Quick-cure gum, either with backing or without vulcanizing cement.

Regular cure tube gum, with or without backing or vulcanizing cement.

Rubber tubing, beveled, with patching cement or acid cure.

Combination backing only, cured over the outside.

Combination backing cured inside and out. Includes patching rubber.

Some use cushion stock and sometimes tread gums for tube vulcanizing.

Curing agents used are:

Flat tube plate with spring clamp, "C" clamp or weight pressure and using steam.

Gasoline vulcanizers in which pressure is applied between two plates by the use of thumb screws, the upper part being made to hold a small amount of gasoline which is lighted to generate heat while burning.

Electric vulcanizer.

Saltpeter or acid chips which are lighted and burn slowly. They are held between two plates by grip or screw pressure. Used either for small holes or extended work.

Portable steam vulcanizer heated by gasoline or electricity.

MATERIALS

The materials consist of cements, tube filler gum, combination backing gum, cementless patches, khaki

back gums, valve assemblies, valve pads, and good gasoline, together with tools as shown under tool list.

The kinds of cement that can be used in repair work include: vulcanizing, which requires curing or vulcanizing; patching or air-drying cement, which is applied and dried, and acid-cure cement, over which carbon disulphide (acid) is brushed as the parts are applied.

Tube filler gum can be secured in any thickness in red, black and grey. A thickness of 1/32″ in the fifteen minute cure type is preferred for this method to a shorter five minute cure kind. Combination, or backing gums, with one cured side to prevent sticking to the tube can be secured under the same cures.

Cementless patches are applied cold by dipping in gasoline and applying under pressure for a short time. Khaki-back gums can be secured for use with or without patching cement.

Valves saved from old tubes and used when possible.

GENERAL TUBE REPAIR INFORMATION

1. The requirements for good tube repairing are cleanliness, high grade gasoline, proper buffing, and sealing.

2. All tubes should be inflated to a good body, especially for slow leaks. Submerge in the test tank and carefully inspect the valve core, valve base, splice and old cold patches. When cured, they should be re-inflated and carefully tested.

3. If doubtful, and unable to find a small leak, tighten up the valve nut and set the case up on a rim. Inflate to capacity and test the complete tire, allowing time for the escape of air that is in the rim channels or tire body.

4. When a small leak has been found in the tube, carefully inspect the case for a small nail or piece of glass. It is usually in the tire and will puncture the tube as soon as set up.

Figure 147.—Cutting out and filling tube repair.

5. On road service, wet the finger, which will often locate a small hole. Valve cores should be tested in the same manner.

6. Slow leaks from porous tubes are almost invisible and should be carefully looked for under good light.

7. Should a tube keep going down under pressure in the case, it is usually the valve nut that is loose. This should be tightened up on every tube repaired or sold. The valve core should also be inspected.

8. When removing an old valve core, it is best to insert a new one.

9. All tubes, after repaired and inspected and when not on rims, should be neatly folded by centering the valve and turning the ends in twice, then tying with a cord at each end.

Figure 148.—Steps in repairing hole. 1—the injury. 2—cut out and beveled. 3—backed and filled. 4—sealed. 5—cured.

10. Always slightly inflate tubes when placing in the case.

11. Always rough and bevel every tube hole repair.

12. Always wash all repairs, when buffed, with high grade gasoline, inside and out.

13. All injuries should be cemented inside and out, using care on the bevel.

14. Tubes usually have a grain lengthwise of the tube.

REPAIRING HOLES (CURED METHOD)

The following covers the repair of pin, nail, and small holes, also small or long tears and blow-outs.

running with the tube. If across the tube it is usually a splice repair.

1. Cut around the hole and round the ends of the injury or tear.

2. Buff well inside and out by holding thumbs or fingers under the hole in the tube and stretching, taking care not to split the ends that have been rounded. Bevel on the emery to a feather edge and run back about one-eighth to one-quarter inch.

3. Wash inside and out with high test gasoline.

4. Cement with vulcanizing cement inside and out, one coat, to overlap the bevel on the outside and about one inch all around on the inside. Let dry ten or fifteen minutes.

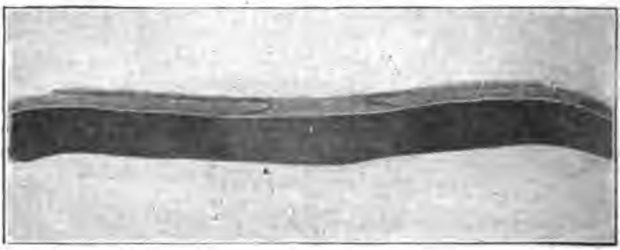


Figure 149.—Cross section of proper repair.

5. Cut a piece of backing or combination gum about one to two inches larger than the injury all around. Grasp the center of the uncured gum with plugging pliers, dip in gasoline to keep from sticking, and slip through the hole. Pull up to the injury, center well and roll down evenly with roller. Do not let backing sag or wrinkle, or a bulged repair will result.

6. Cut tube filler gum in narrow strips, three layers 1/32 inch thick, and fill the cavity by plugging this up against the edges all around. First see that good contact is made and then fill up towards the center. Aim to keep the center slightly high for flow to edges under pressure. Stitch the filler gum down so that all is well united.

7. Take a narrow strip of 1/32 inch filler gum about

¼ inch wide, lap it over the edges of the hole and over onto the new gum. This is the reason for cementing the outside of the hole, as it will seal the repair, eliminate the direct breaking edge between the old and new gum and stop pulling apart when inflated to the arc. Roll well.

8. The tube is now ready for curing, which is continued for fifteen to twenty minutes at fifty-five pounds. If quick-cure gum is used, work according to the time recommended.

Figure 150.—Curing tubes on plate.

9. Center the repair under a rubber pad for even cure, and when clamp is set, hang balance of tube so to touch the plate. Do not apply a block over the edges of the tube.

10. When cured, dip in water, remove holland, and pull the tube apart to prevent sticking inside. Test.

Holes in splices which were made with cold cement usually call for a new splice, as cold cement loosens up under the heat. However, if properly handled, many splices can be repaired as above. All cured splice holes can be handled the same as other parts of the tube.

Figure 151.—Testing for leak.

When repairing a hole near the valve, always remove the valve and slip it inside the tube to secure a flat surface to work on.

Some small hole repairs can be of the rivet type, made by running the cemented brush through the holes and allowing the cement to dry. Then force a plug of filler gum through the hole and fill up on top to be cured in this manner. It is better, however, to cut the hole larger and put in the backing, and it can be done quickly.

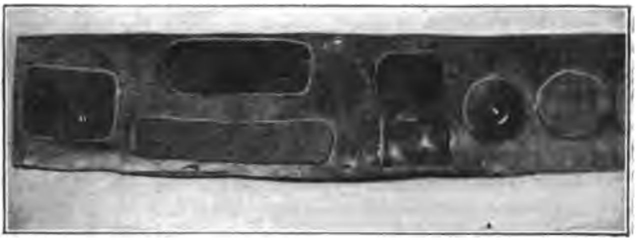


Figure 152.—Cold methods of repair.

REPAIRING HOLES (COLD METHOD)

All cold repairs on inner tubes, gas masks, etc., are made by use of air-drying cement, acid-cure cement, or cementless patches. A good grade of repair stock is essential. This method of tube repairing is not recommended, as heat and friction will in time loosen the work. They are used only in road service cases or in rough repairs, in which the time is too short to permit vulcanizing.

1. Buff or sandpaper the surface of the tube for about one inch around the injury.
2. Wash with gasoline.
3. Apply a coat of patching cement larger than the patch.

to be applied and cement the patch or khaki-back (a piece of tubing can be used). Allow to dry until tacky, but not overnight if in the shop.

4. Apply a second coat and allow to dry as before. Also apply on patch.

5. Place the patch over the hole and roll down well until set. Apply some pressure, if possible, for about twenty minutes.

6. If using the acid-cure method, handle in the same way, brushing the acid over the patch, which is then applied with a steady pressure. Acid cures quickly and the patch should be on and in place within about ten seconds.

7. When using the cementless patch or khaki-cloth, the hole is roughed with sandpaper and cleaned, the patch is dipped in gasoline of good grade, and, as the gasoline is evaporating, the patch is pressed down over the injury and centered with pressure for a short time or until set. Khaki-cloth can be cut in width or length and applied.

VALVE PADS OR BASES

Valve pads can be applied with vulcanizing, air-drying, or acid-curing cement. The patching or air-drying method works very well for this application, as no great strain is placed on the pad when the valve is set.

1. Remove the valve nut, bridge washer and valve washer, and slip the valve inside the tube. Never pull a valve through the valve hole if the pad is to be used again as it will tear the reinforcement in the pad.

2. Remove the old pad, either by heating on the tube plate for a few minutes or by buffing off. Buff, bevel, and cement the old hole for a hole repair.

3. Select another place on the tube and buff off slightly larger than the valve pad to be used.

4. Wash with gasoline and cement two coats with patching cement or acid-cure.

5. Buff, wash and cement the new valve pad in the same manner. Let dry.

6. Apply the pad on the tube, roll down well and place a weight on over a rubber pad to give pressure until set.

7. Take a narrow, sharp knife, pinch the pad hole until the inner tube bulges up, then cut out for the valve hole, following the edges of the pad hole.

8. Insert the valve and set up.

It is important to remember that a new valve pad can be added more easily at another place on the tube and will give better strength. If desired, vulcanizing cement can be used and the pad cured on the tube plate. A small matrix can be made in a thin piece of old tubing by cutting it out to fit over the pad.

Figure 153.—Valve pads and valves. 1—tube buffed and cemented. 2—valve pad applied. 3—valve inserted.

VALVES

The parts of the valve assembly consist of the valve stem, valve washer, bridge washer or spreader, valve nut, valve core, valve cap, dust cap and rim nut.

1. In removing a valve from the tube, always cut a small hole at one end of the pad and remove the valve through this hole. Never pull it through the valve hole.

2. Valves from junk tubes should be saved and polished on the buffer for use in replacement.

3. When the valve core notches are worn off, sharpen the handle of a file and tap into the core head to turn it out.

4. Should the rubber seat stick or the core refuse to turn, heat the valve over a flame, which will loosen the parts.

5. Cores should always be examined when replacing or when making a repair.

6. Some leaks, while on the car, may be due to the rubber in the valve cap depressing the valve core when the cap comes down too far.

7. Use the length valve designed for the size of the tube in all cases. Short valves are used for clincher and Q. D. rims; long valves on demountable rims.

8. Worn or torn out valves are usually due to the rim creeping on the wheel or to underinflation which causes the tire to creep.

9. All valve threads should be trimmed by using the valve tools so that cores or caps fit perfectly.

10. Bring the valve nut up tight on all valve assemblies.

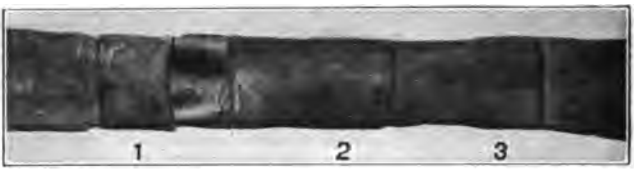


Figure 154.—Making a splice. 1—buffed and cemented. 2—pulled into place. 3—edge beveled.

SPLICING TUBES

Large holes, tears and leaky splices which cannot be repaired under the regular methods usually require the replacement of a section of the tube. Sections of tube for this work are usually secured from old tubes of the corresponding size. Use only good sections of the same color and fresh and free from wrinkles or stretching. Tube sections can be brought in the same manner as regular repair materials.

1. Leaky splices in some cases can be loosened by heating or by using gasoline. It is better, however, to cut out the old splice and place a new section, and this is ordinarily quicker. More care is required for splicing than in other

tube repairing, and unless the habit of doing the work correctly is developed at the start, tube splicing will be unsuccessful.

2. Splices are connected or spliced with the same cements as pads; namely, by vulcanizing, air-drying cement or acid-cure cement.

3. When cutting the new section, it should be about three inches longer on each end than the section cut out, or six inches altogether. This allows for the splice. Care should be taken to note that the new section fits either inside or over the ends of the old tube, the buffing then being done to correspond to the best fit.

4. The ends of the new section, as well as the ends cf the tube, are then roughed and buffed back to clear the three inch allowance for the splice, one being roughed inside and one out. The ends are beveled by grinding on the emery stone or by placing them over a pipe of the same diameter and cutting a perfect bevel to the end with a sharp knife. The bevel should be roughed on the buffer, taking care not to rag or tear through the edges.

5. If making a mandrel splice, the end of the tube is inserted in the female and turned back for three inches. The section end is placed in the male mandrel and turned back for six inches, after which the end is doubled back to the edge of the mandrel. Both surfaces are then washed with gasoline and cemented with two coats of whatever cement is being used, each to dry until tacky.

6. If using patching cement, the male mandrel is put into the female quickly, and this brings the tube end down on the new sectional splice. The splice is then wrapped tightly with cloth or bandage for a short time to allow setting of the cement. Strips of old tubes may be used for wrapping, as this improves pressure on good splices. Before joining splices, see that the tube is not turned or twisted.

7. If using acid-cure cement, the cemented ends are brushed quickly with the acid and the same procedure followed as in 6.

8. If vulcanizing cement is used, the splice lap can be about two inches. After being cemented, a thin layer of tube gum can be laid around the male end.

9. In making hand splices, the same operation is fol-

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SINGLE TUBE BICYCLE TIRES

Repairs to bicycle tires are usually of the single tube variety. These are made in two ways; for small nail holes, or for blow-outs.

In the small nail hole repair, the hole is plugged with special rubber plugs, or rubber bands are stretched on what is termed a jiffy tool. This tool is a split needle with a single forked end into which the rubber band is placed and wound around a small arm on the tool and back through the fork. Several bands are added in this way until sufficient to plug the hole. Patching cement is then forced inside the hole with a small tube and screw cap and the tube removed. The bands are dipped into cement and pushed through the hole. When the bands are slowly released from the arm on the fork the ends of the bands roll and expand, plugging the hole from the inside. The outer ends can be trimmed to within about one-eighth inch of the tube or closer. The tire is then inflated and tested.

In the repair of blow-outs, a sectional repair is made under a different procedure than that for large tires.

1. Remove the rubber by cutting or buffing for about two inches on each side of the injury and completely around the tire.
2. Remove one ply of fabric about one-half inch inside of the removed treadline.
3. Lightly buff the fabric and edges of the remaining tread.
4. Skive the edges of the injury.
5. Wash all dirt from the inside of the tire with gasoline for three or four inches each way from the injury.
6. Apply vulcanizing cement outside and inside the repair.

7. Cut a piece of combination tube backing to lap the hole or injury by one inch or more if possible. Dip it in gasoline and insert as in tube repairs. Pull up against the injury, being sure to center well.

8. Fill the injury with tube gum or cushion.

9. Slightly inflate the tire to give a rounded body.

10. Cut bead cover straight to fit and lap over the step cut out. This is applied by starting at the rim side and is carried completely around the tire to overlap again on the rim side. Another ply is added over this.

Note—Some repairmen cut the bead cover about one-half the width across the step and wrap it twice around the tire, or more if necesary, starting and lapping on the rim side.

11. Apply tread gum on the side wall and tread. Roll and stitch well.

12. The tube is then inflated to riding pressure, usually about forty pounds, and placed in a special bicycle tire vulcanizer and cured for thirty minutes at fifty-five pounds, or forty minutes at forty pounds.

CHAPTER XII

ACCOUNTING RECORDS AND REPAIR DATA

No repair shop can be considered efficient or business-like unless complete records are kept. In connection with good equipment and a knowledge of repair operations, it is necessary for the owner of the shop to adopt some inexpensive system of accounting and a regular order in which the work is to be done. A record of every repair can then be quickly traced should the occasion arise. The system should be one that is easily connected with all office books and other records. No records should be destroyed or thrown away at any time, for future reference may be required.

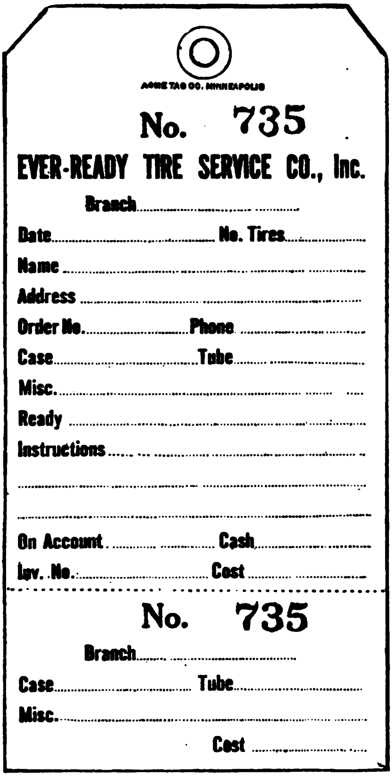
The system outlined is one that has been found to give satisfactory results for any sized shop.

FORMS

Repair Tag.—The repair tag is very important, being used for identification of the work, work done, and the charges and work estimated or done. This tag should be numbered consecutively in quantities to suit the amount of business.

The repair tag should never leave the shop under any consideration, and all information such as "on rim," "on wheel," "cover to go," "time to be ready," etc., should be listed on the tag when the work

is received and dismounted. Always tie the tag on the tire or tube, never to the rim or cover, as a dummy tag should be used for this purpose.



No. 735

EVER-READY TIRE SERVICE CO., Inc.

Branch ....

Date .... No. Tires ....

Name ....

Address ....

Order No. .... Phone ....

Case .... Tube ....

Misc. ....

Ready ....

Instructions ....

....

....

On Account .... Cash ....

Inv. No. .... Cost ....

No. 735

Branch ....

Case .... Tube ....

Misc. ....

Cost ....

Figure 155.—Repair tag.

Some repair shops use a duplicate tag to advantage in many ways. It is the same as above, except that

an identification tag is attached and removed on a perforated line.

The Dummy Tag.—Usually consists of a blank tag tinted so to take pencil. It is about $1\frac{5}{8}x3\frac{1}{2}$ inches in size and used for attaching to rims, covers, or tubes on which no work is to be done, but which must be held for set-up. On this tag is placed the customer's name and the number of the repair tag

Name ______________________________

Set Up ______________________________

Case Tag __________ Tube Tag __________

Promised ______________________________

Figure 156.—Form for dummy tag.

on which work is being done. This enables a complete set-up to be quickly made without error, especially when customers have many tires in at one time for repair. The dummy tag is also used for a rush tag. That is, when a repair must be done at a certain time, a colored dummy tag is attached with the repair tag. The colored tag will at all times denote a special repair to be attended to at the time shown and it can be worked on first when among several tires or tubes.

The Blotter.—In connection with the repair tag, in large shops, a blotter should be provided to list all tag numbers as used. The name, the date, whether a case or tube, and the customer's order number are

Date Received	Factory Number	Branch Number	Case	Tube	Mics.	Set-Up

NAME	ADDRESS

Order Number	Date Ready	REMARKS

Figure 157.—Column headings for repair blotter.

noted. A large ruled book usually answers the purpose and will last indefinitely. The numbers are arranged numerically, as are the tags. The use of the blotter is a check against the repairs coming back from the shop, also as a follow-up on rush work and for a complete record of every repair job received.

The blotter will be found convenient for checking off the tags as they come into the office and for checking back on cash receipts after the tag has been filed. A customer may pay cash and there may be no direct record of the individual tag; however, knowing the approximate time the work was brought in, the blotter can be run over, the name located the tag number secured and the filed tag found in its numerical order. This will show the customer the work done.

The Invoice.—Invoices are usually in duplicate, consecutively numbered, and in pads. These can be made for typewriter or pencil billing. The purpose of the invoice is to list the charges for the individual customer, either daily or monthly, as the case may be. One or more tags can be entered on an invoice, the tag numbers showing before each item of work. The original is given or mailed to the customer and the duplicate is filed in numerical order on the file. The invoices for each month are kept together after they are posted to the customer's ledger. Credit invoices can be made.

The Customers Ledger.—The customers ledger may be either loose-leaf or cards arranged alphabetically. The individual invoice amount is entered on the individual ledger card for the customer; the date invoice number, and amount being shown.

A quantity of invoices with the number blank

should be provided for forwarded or for duplicate invoices.

The foregoing system is given only as a standard to work with any system of office books. When a complete accounting system is installed with the required books, such as cash book, creditors' ledger, special column journal, general ledger, etc., it will be found that this system will work in well.

The object of a special column journal is to cover the entire distribution of the business, and these journals can be secured with double entry columns for:

Bank: In which all deposits and checks are entered.

Cash: Showing cash receipts and disbursements.

General Expense: To the business as charged.

Customers Ledger Column: In which customers are credited and the total of invoices charged monthly.

Creditors Ledger Column: In which the creditors are charged for all payments to them and credited with their bills.

Interest and Discount: Allowed or received.

General Ledger: In which accounts not provided for by special column are charged or credited.

A number of blank columns are also provided which can be headed "Tire Account," "Repair Account," "Accessory Account," etc., and their footings, including an inventory, will show the profit made, with expense deductions. Blank columns for expense distribution are also provided.

The special column journal is cleared to the general ledger monthly in total footings, with the exception of such items as shown in the general ledger column,

and these are posted individually to the proper account.

The creditors ledger can be a loose-leaf or card ledger similar to the customers ledger, but usually of a different tint and kept alphabetically in a separate box or cover.

REPAIR COSTS AND WEIGHTS

It is essential for success that the repairman have a complete record of the materials and labor connected with making the various repairs, in order that he may set a price on the finished work. The habit of referring to a competitor's price list in order to establish fair charges for repair work leads to either inflated or low prices.

When the amount of material to be used is known, the shop owner can also determine whether or not his repairman is wasteful. It is out of the question for the smaller shop to establish a material cost system, in fact, tire repair shops would waste half their time weighing and figuring materials used. Unless a competent cost accountant thoroughly versed in the work was employed, the weights would not be found reliable in a general run of work.

To overcome this disadvantage the following table of weights has been assembled from actual weights on all repairs. Should other repair weights be desired, it is only necessary to add them to the list by following the outline and keeping the record complete as a new system or work is developed. These weights of materials on repair operations cover all standard stocks and have been made to include the trim in all cases.

Money costs have been dispensed with, due to the fluctuations in prices on materials. Various companies may have different prices for small or large quantities, among other fluctuations. A price extended table would be impractical for general use. Under the present arrangement it is only necessary to fill in the cost per unit for any sized shop and the cost is then accurate at the price paid for materials.

Labor should be based on the average wage paid at the shop or can be based on fifty cents per hour.

To the cost of material and labor should be added the overhead expense pro rata for the number of tires repaired monthly, or a percentage equivalent can later be added.

The total charge then can be determined, allowing a fair return on the work done, it being remembered that the percentage of profit in the tire repair business must necessarily be larger than in most lines. This is due to the variation of income from one repair or a few, and which, without a continuous volume, would not compensate the owner to any extent. It should be remembered that business volume is only available for about six months out of the year and that a considerable portion of the overhead goes on the year round.

Under the heading of materials in the following tables will be found the items that are mostly encountered.

Materials.—Vulcanizing cement for all work. 12 oz. = 1 pt. Cut 2 to 1.

Cushion gum, 1/32″ or 1/64″, for fabric and cords

Fabric gum, C 1, for rebuilding fabric tires.

Cord fabric, F 2, C 2, for rebuilding cord fabrics

Cable cords for rebuilding cable cord tires.
Bead cover, light or heavy, for all work.
Breaker.
Tread gums.
Side wall gums.
Retread bands.
Reliners.
Labor.—Cutting.
Buffing and cementing.
Building.
Set-up.

Tables shown are for the standard eight-inch section as a basis of repair. This is the minimum, and the additional inch weights, once priced, can be added to the eight-inch section for any number of inches.

Cements are given in ounces based on an actual weight of twelve ounces to the pint when cut two-to-one with high test gasoline.

Time is given for an average repairman in a good sized shop. It is optional with the shop as to the production of its employees, and this ranges considerably. The time as given will average consistently for the monthly run when a volume of work is done.

RETREADS (FABRIC TIRES)

(Fabric Tire with Raw Gum or Camel Back)

	28x3"	30x3"	30x3½"	32x3½"	33x4"	34x4"	35x4½"	36x4½"	37x5"
Cement, Oz.	4½	5	6	7	9	10	12	14	16
Cushion, Oz.	9	10	10¾	11½	15½	16	18	18½	19½
Tread Gum, Oz.	50	54	59½	64	98	101	137¼	141¼	164
Breaker, Oz.	7	7	8	8½	10½	11	12¼	12½	14
Cutting, Min.	25	25	30	30	30	30	30	35	35
Buff and Cement, Min.	25	30	30	30	35	35	35	40	40
Building, Min.	40	45	45	45	50	50	50	60	60
Set-up, Min.	20	20	25	25	30	30	30	30	35
1/16 Ply Used	3	3	3	3	4	4	5	5	5

Set-up is either for wrapping or one-third circle mould cure.

Camel back weights run considerably less than the above weights. Three sizes of camel back are used; namely, one die to cure two sizes in width. However, as side strips are usually used on large tires, the weight will be brought up. Camel back weights alone, without the tire strip weights, approximate:

On a 30"x3½" tire, 3¾ pounds.
On a 34"x4" tire, 4¾ pounds.
On a 37"x5" tire, 6¼ pounds.

RETREADS (FABRIC OR CORD TIRE)

(With Retread Band and Side Strip)

	28x3"	30x3"	30x3½"	32x3½"	33x4"	34x4"	35x4½"	36x4½"	35x5"	37x5"
Cement, Oz. ...	4½	5	6	7	9	10	12	14	15	16
Cushion, Oz. ..	9	10	10¾	11½	15½	16	18	18½	19	19½
*Tread Gum, Oz.	9½	10	10	10½	10¾	11¼	11¾	12½	11¾	13
Breaker is used, Retread Band .	1	1	1	1	1	1	1	1	1	1
Oz.	7	7	8	8½	10½	11	12¼	12½	13	14
Cutting, Min. .	25	25	30	30	30	30	30	30	35	35
Buff and Cement, Min.	25	30	30	30	35	35	35	40	40	40
Building, Min..	25	25	30	30	30	30	35	35	35	35
Set-up, Min....	20	20	25	25	30	30	30	30	35	35

Set-up covers either wrapping or one-third circle mould cure.
*For side strip one inch wide.

COMPLETE SECTION

Fabric Tire (Layback Type)

This repair is made outside from bead to bead

	3 inch		3½ inch		4 inch		4½ inch		5 inch	
	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.
1. Cement, Oz.	3	¼	3½	¼	4	¼	4½	¼	5	¼
Cushion 1/32″, Oz.	1¾	¼	2¼	¼	2¼	¼	2½	¼	2¾	¼
2. Fabric, Oz.	5	½	6	¾	6¾	1	11	3	12	4
3. Bareback, Oz.	2	¼	2¼	¼	2¼	¼	3	¼	3	¼
4. Side Wall, Oz.	1½	¼	2¼	¼	2¼	¼	2½	½	2½	½
5. Tread, Oz.	1½		1¾		1¾		2		2	
Cutting, Min.	20		25		30		35		35	
Buff and Cement, Min.	15		15		20		25		25	
Building, Min.	25		25		25		35		35	
Set-up, Min.	15		15		15		15		15	
Ply	Out 2—In 3		Out 2—In 3		Out 2—In 3		Out 4—In 5		Out 4—In 5	

1. Cement two coats, Cut 2-1.
2. Fabric includes reinforcement.
3. To cover reinforcement.
4. Two new side wall strips.
5. For filling up injury, averaged.

THREE-QUARTER SECTION

Fabric Tire (Layback Type)

This repair leaves one side wall. Same as complete section in other details

	3 inch		3½ inch		4 inch		4½ inch		5 inch	
	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.
Cement, Oz.	2½	1/6	3	1/6	3½	1/6	4	¼	4½	¼
Cushion 1/32″, Oz.	1¾	¼	2¼	¼	2½	¼	2½	¼	2¾	¼
Fabric, Oz.	4¼	½	4¾	¼	5¾	½	6¾	1¼	8	1½
Bareback, Oz.	2	¼	2¼	¼	2¼	¼	3	¼	3	¼
Side Wall 1/16″, Oz.	¾	⅛	1⅛	⅛	1⅛	⅛	1¼	¼	1¼	¼
Tread 1/16″, Oz.	¾		⅞		⅞		1		1	
Cutting, Min.	20		20		25		30		30	
Buff and Cement, Min.	15		15		20		20		20	
Building, Min.	20		25		25		30		30	
Set-up, Min.	15		15		15		15		15	

SIDE SECTION

Fabric Tire (Layback Type)

This repair is made for rim cuts, usually without removing tread

	3 inch		3½ inch		4 inch		4½ inch		5 inch	
	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.
Cement, Oz.	2¼	¼	2¾	¼	3	¼	3¼	¼	4	¼
Cushion 1/32″, Oz.	¾		¾		¾		⅞		⅞	
Fabric, Oz.	2¾	¼	3	¼	3½	¼	4¼	½	5	½
Bareback, Oz.	2	¼	2¼	¼	2¼	¼	3	¼	3	¼
Side Wall 1/16″, Oz.	¾	⅛	1⅛	⅛	1⅛	⅛	1¼	¼	1¼	¼
Cutting, Min.	20		20		20		25		25	
Buff and Cement, Min.	15		15		20		20		20	
Building, Min.	20		20		20		30		30	
Set-up, Min.	15		15		15		15		15	

INSIDE SECTION

Fabric Tire (Inside)

Used on small breaks by some repairmen

	3 inch		3½ inch		4 inch		4½ inch		5 inch	
	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.
Cement, Oz.	1¼	⅛	1½	⅛	1½	⅛	2	⅛	2½	⅛
Cushion 1/32″, Oz.	¼		⅜		½		⅝		¾	
Fabric, Oz.	2½	¼	3	½	3¾	½	4½	¾	5	1
Bareback, Oz.	2	¼	2¼	¼	2½	¼	2¾	¼	2¾	¼
Cutting, Min.	10		15		15		20		25	
Buff and Cement, Min.	10		10		10		15		15	
Building, Min.	15		15		15		20		25	
Set-up, Min.	15		15		15		15		15	

Use tread patch if outside repair is made.

TREAD SECTION

(Any Tire)

	3 inch		3½ inch		4 inch		4½ inch		5 inch	
	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.	8″	addl. in.
Cement, Oz.	1	⅛	1	⅛	1	⅛	1 1/5	⅛	1 1/5	⅛
Cushion 1/32″, Oz.	1	¼	1	¼	1	¼	1¼	¼	1½	¼
*Fabric, Oz.	2	¼	2	¼	2	¼	2½	¼	3¼	½
*Bareback, Oz.	1¾	¼	2¼	¼	2¼	¼	2¾	¼	3½	½
Breaker, Oz.	½	¼	½	¼	¾	¼	1	¼	1	¼
Tread 1/16″, Oz..........	4½	½	6¼	½	9	1¼	10¼	1¼	12¾	1½
Cutting, Min.	10		10		10		15		15	
Buff and Cement, Min....	10		10		10		15		15	
Building, Min.	15		15		15		20		20	
Set-up, Min.	10		15		15		15		15	
Plies Used	3		3		4		4		4	

*Used for complete reinforcement to the repair.

TREAD PATCH

(Any Tire)

	3 inch 4″	3 inch addl. in.	3½ inch 4″	3½ inch addl. in.	4 inch 4″	4 inch addl. in.	4½ inch 4″	4½ inch addl. in.	5 inch 4″	5 inch addl. in.
Cement, Oz.	½	1/16	½	1/16	½	1/16	3/5	1/16	3/5	1/16
Cushion, Oz.	½	⅛	½	⅛	½	⅛	⅝	⅛	⅞	⅛
*Fabric, Oz.	½	¼	1	¼	1	¼	1¼	¼	1¼	¼
*Bareback, Oz.	¾	¼	3¼	¼	1¼	¼	1½	¼	1¾	¼
Breaker, Oz.	¼	⅛	¼	⅛	⅜	⅛	½	⅛	½	⅛
Tread, Oz.	2¼	¼	3⅛	¼	4½	½	5⅛	½	6⅜	¾
Cutting, Min.	5		5		5		10		10	
Buff and Cement, Min.	5		5		5		10		10	
Building, Min.	10		10		10		15		15	
Set-up, Min.	15		15		15		15		15	

*For small reinforcement.

REINFORCEMENT

(Large, when used alone)

	3 inch 8″	addl. in.	3½ inch 8″	addl. in.	4 inch 8″	addl. in.	4½ inch 8″	addl. in.	5 inch 8″	addl. in.
Cement, Oz.	1	¼	1½	¼	1½	¼	2	¼	2½	¼
Cushion, Oz.	¼	⅛	⅜	⅛	½	⅛	⅝	⅛	¾	⅛
Fabric, Oz.	¾	¼	1	¼	1½	¼	2½	¼	2½	¼
Bareback, Oz.	2	⅛	2¼	⅛	2¼	¼	3¼	¼	3¼	¼
Buff and Cement, Min....	5		5		5		10		10	
Building, Min.	15		15		15		20		20	
Set-up, Min.	15		15		15		15		15	

REINFORCEMENT

(Small, for nail holes. Any tire)

	4″	addl. in.
Cement, Oz.	¼	⅛
Cushion, Oz.	1/6	1/32
Fabric, Oz.	½	¼
Bareback, Oz.	¼	⅛
Cutting, Min.	5	
Buff and Cement, Min....	5	
Bui' 'ing, Min.	5	
Set-up, Min.	15	

COMPLETE SECTION

(Cord Fabric Tire, Layback Type)

Built up of heavy cord fabric.

	3½ inch	8" addl. in.	4 inch	8" addl. in.	4½ inch	8" addl. in.	5 inch	8" addl. in.	7 inch	8" addl. in.
Cement, Oz.	4	¼	5¼	¼	6½	½	8¾	½	1½ pt.	½
Cushion, Oz.	2¾	¼	3	¼	3⅛	¼	3¼	¼	17	½
Cd. Fabric, Oz.	26	2½	29½	3	30	4	32¾	4½	6¾ lbs.	8
Bead Cover, Oz	1⅛		1¼		1½		1¾		5	⅛
Side Wall, Oz	2½	¼	3¼	½	4	½	4½	½	7	½
Tread, Oz.	1½		2		2		2½		3	
Cutting, Min.	50		60		70		75		2½ hrs.	
Buff and Cement	20		20		25		25		30	
Building, Min.	35		40		50		50		2 hrs.	
Set-up, Min.	15		15		15		15		15	
Plies out	4 out—5 in.		4 out—5 in.		4 out—5 in.		5 out—6 in.		6 out—7 in.	

Common fabric, when used, is in even plies and weighs two-thirds of cord fabric.

Light cord fabric, when used, is one-half of heavy cord fabric.

Section on seven-inch tire represents 30-inch tread section removed and replaced after carcass section is first cured. Also add one large cord boot or reinforcement which is used to back up the section.

Note.—The complete section is mostly used in cord fabric repairs, the other repairs being similar to fabric.

AIRPLANE TIRES

(Cable Cord Type)

	4″ Tire Complete Sect. 8″	addl. in.	Tread Sect. 8″	addl. in.	Tread Patch 4″	addl. in.
Cement, Oz.	4	¼	1	¼	½	1/16
Cushion, Oz.	2	¼	½	⅛	¼	⅛
*Cd. Fabric, Oz.......	15½	1¼	3¾	½	1½	¼
Bead Cover, Oz......	⅜	1				
Side Wall, Oz........	1½	¼			1	¼
Tread, Oz.	1		3⅝			
Cutting, Min.	40		15		5	
Buff and Cement....	20		15		10	
Building, Min.	30		20		10	
Set-up, Min.	15		15		15	

*Including Reinforcement.

CABLE CORD REPAIRS

	3 inch inner Cord Section	3 inch outer Cord Section	3 inch inner and outer Cord Section	8 inch Cord Separation
Cement, Oz.	2½	6	6	2
Cushion, Oz.	2	2½	2½	1½
Cable Cords, Oz........	3	3¼	6¼	
Bead Covers, Oz........	3	4	4	2
Side Wall, Oz...........		1	1	
Tread, Oz.		5	5	
Cutting, Min.	25	35	60	20
Buff and Cement........	15	20	35	20
Building, Min.	30	50	60	25
Set-up, Min.	15	15	15	15

Note.—The above cord statistics were figured on all sizes in the cross-section, and the fluctuation was only a few cents. The additional inches can be averaged from the above.

COMPLETE REBUILDING

(Includes gum retread and three ply carcass reliner, all cured)

	30″x3½″	34″x4″	37″x5″
Cement, Oz.	18	26	36
Cushion, Oz.	10¾	16	19½
*Fabric, Oz.	½	¾	1
Carcass Reliner	1	1	1
Tread, Oz.	59½	101	164
Cutting, Min.	60	65	70
Buff and Cement, Min........	60	75	80
Building, Min.	70	80	85
Set-up, Min.	80	80	80

*Pieces for nail holes.

Note—The additional cost of sections, etc., should be added to above when used.

INSERTING RELINERS

Size	Cement	Reliner	Time Buff and Cement Tire and Reliner	Time to Insert
30″x3″	12 oz.	1	30 min.	20 min.
30″x3½″	13 oz.	1	35 min.	20 min.
32″x3½*	14 oz.	1	35 min.	20 min.
33″x4″	15 oz.	1	40 min.	20 min.
34″x4″	16 oz.	1	40 min.	20 min.
32″x4½″	16 oz.	1	45 min.	20 min.
34″x4½″	17 oz.	1	45 min.	20 min.
35″x4½″	17 oz.	1	45 min.	20 min.
36″x4½″	17 oz.	1	45 min.	20 min.
35″x5″	18 oz.	1	50 min.	20 min.
37″x5″	20 oz.	1	50 min.	20 min.

Insertion of reliners in a large tire is easier than on a small tire.

TUBE REPAIRS

	Small Hole	Large Hole	Extra Lge. Hole	Tears to 6″
Filler Gum, Oz.......	⅛	¼	1	⅓
Combination, Oz.....	⅛	¼	1	⅓
Vulc. Cement, Oz....	1/16	⅛	¼	⅛
Patching, Oz.				

	Small Hole	Large Hole	Extra Lge. Hole	Tears to 6"
Pad only				
Valve only				
Repair Labor	4 min.	5 min.	5 min.	5 min.
Change Labor	5 min.	5 min.	5 min.	5 min.

	Pads	Valves	Splice
Filler Gum, Oz...........		1	
Combination, Oz..........			4" tube
Patching, Oz.............	¼		¼
Pad Only	1		
Valve Only			4½ oz.
Repair Labor	15 min.	10 min.	30 min.
Change Labor	5 min.	5 min.	5 min.

Fifty percent of tubes brought in are on rim. Allowing 10 minutes each for break-down and set-up will add 5 minutes each to the repair as shown.

COLD PATCHES, INCLUDING EVERLOCK

(2 Coats Used)

	Small Patch	Large Patch	Tears to 6"
Patch	1	1	
Everlock	½ oz.	2 oz.	4 oz.
Patching Cement.....	⅛	¼	¼

Labor—Same as on cured work.

WEIGHTS AND STATISTICS ON MATERIALS

These weights, as given, cover a general average of stocks or other items as made by different makers. Some difference will be found when individual weights are made.

	Quantity Equals	Weight	
Acid, carbon disulphide.....	1 Qt.	2½ lbs.	
Bands, ribbed retread.......	32"x3½"	5¼ lbs.	4½" wd.
	32"x4"	6 lbs.	5" wd.
	34"x4"	6 lbs.	5" wd.
Bands, with breaker........	34"x4½"	6¼ lbs.	5½" wd.
	35"x4½"	7¼ lbs.	5½" wd.
	35"x5"	8½ lbs.	6" wd.
	37"x5"	8¾ lbs.	6" wd.

	Quantity Equals	Weight	
Bands, non-skid, retread....	32"x3½"	4 lbs.	4½" wd.
	32"x4"	4¼ lbs.	5¼" wd.
	34"x4"	4½ lbs.	5¼" wd.
Bands, no breaker...........	34"x4¼"	5 lbs.	6" wd.
	35"x4½"	6 lbs.	6" wd.
	36"x4½"	7 lbs.	6" wd.
	35"x5"	7¾ lbs.	6½" wd.
	36"x6"	21¼ lbs.	9¼" wd.
	38"x7"	23 lbs.	10½" wd.
Backing, waxed paper.......	Sq. yd.	4 oz.	
Backing, cloth to fabrics.....	Sq. yd.	3½ oz.	
Caps. valve	160	1 lb.	
Cement, patching	1 pt.	15 oz.	
Cement, vulcanizing	1 pt.	12 oz.	
Fabric, building F 2 C 1....	1 sq. yd.	2 lbs. average	
Fabric, bareback F or C 1..	1 sq. yd.	1½ lbs. average	
Fabric, breaker, F 2 C 2....	1 sq. yd.	2.9 lbs. average	
Fabric, bead cover lgt. F 2..	1 sq. yd.	1.3 lbs. average	
Fabric, bead cover hvy. F 2..	1 sq. yd.	1.9 lbs. average	
Fabric, everlock	1 sq. yd.	1.7 lbs. average	
Fabric, cord, light wgt......	1 sq. yd.	1.8 lbs. average	
Fabric, cord, med. wgt......	1 sq. yd.	3 lbs. average	
Gum, tread, 1/16...........	1 sq. yd.	4.2 to 5 lbs. average	
Gum, tread, 3/64............	1 sq. yd.	3 lbs. average	
Gum, combination tube.....	1 sq. yd.	3.4 lbs. average	
Gum, tube filler, 1/32.......	1 sq. yd.	2 lbs. average	
Holland cloth	1 sq. yd.	3¾ oz.	
Pads, motorcycle valve.....	62	1 lb.	
Pads, small tube...........	40	1 lb.	
Pads, medium tube.........	26	1 lb.	
Pads, large tube...........	20	1 lb.	
Patches, small cementless...	400	1 lb.	
Patches, medium cementless.	160	1 lb.	
Patches, large cementless...	128	1 lb.	
Patches, medium cord......	1	1 lb.	
Patches, large cord........	1	2½ lbs.	
Soapstone	1 pt.	1 lb.	
Staples, cord, small........	486	1 lb.	
Staples, cord, large.........	272	1 lb.	
Valve nuts, small..........	352	1 lb.	

	Quantity Equals	Weight
Valve nuts, medium........	252	1 lb.
Valve nuts, large...........	112	1 lb.
Washers, bridge, small.....	129	1 lb.
Washers, bridge, medium...	32	1 lb.
Washers, bridge, large......	30	1 lb.
Wood cores for stock rolls..	20″ lg.	26 oz.
Wood cores for stock rolls..	54″ lg.	39 oz.
Paper cores for stock rolls..	20″ lg.	3 oz.
Valves, small aeroplane.....	24	1 lb.
Valves, small tube..........	7	1 lb.
Valves, medium tube.......	6	1 lb.
Valves, large tube..........	5	1 lb.
Valves, extra lge. tube......	4	1 lb.

WIDTH AND LENGTHS OF SHOP MADE BLOW OUT PATCHES AND BOOTS

	Widths	Length	Number of Ply	Boots Longer
3″	7″	8″	3	
3½″	8″	9″	4	
4″	9″	12″	4	
4½″	9½″	12″	5	
5″	11½″	12″	5	

Reliners are made wider to allow for trim.

TIRE WEIGHTS

Showing approximate weights of tires.
Weights are slightly more than junk, two and four pounds.
Wear is to be figured.

Size	Fabric Plain	N. S.	Cords Ribbed or Plain	Cords N. S.
28″x3″	8	9		
30″x3″	10	11		
30″x3½″	14	15		17
32″x3½″	14	15	20	20
31″x4″	18	19		
32″x4″	19	20	22	23
33″x4″	19½	20½	24	24
34″x4″	20	21	25	26

33"x4½"	24	25	28	29
34"x4½"	28	30	31	32
35"x4½"	29	30	32	33
36"x4½"	31	32	31	34
33"x5"			33	34
35"x5"	33	34	36	37
37"x5"	36	37	37	39
36"x6"	54			62
38"x7"			65	87
40"x8"				100
42"x9"				130

FLOATING FLAPS

3" — 3½" — 15 ft. — 1 lb.
4" — 10½ ft. — 1 lb.
4½" and 5" — 8½ ft. — 1 lb.

TABLE OF RIM MEASUREMENTS AND CORRESPONDING BEAD FILLER LENGTHS

Rim Size	Oversize Tire for Same Rim	Rim Diam. at Tire Seat	Rim Diam. at Bead	Length of Bead Filler Required
32"x3½"	33"x4"	25"	26"	161"
34"x3½"	35"x4"	27"	28"	175"
32"x4"	33"x4½"	24"	25"	157"
34"x4"	35"x4½"	26"	27"	169"
36"x4"	37"x4½"	28"	29"	182"
32"x4½"		23"	26¼"	152"
34"x4½"	35"x5"	25"	26¼"	161"
36"x4½"	37"x5"	27"	28¼"	176"

SCALE FOR CUTTING AND FITTING RELINERS

	Flat Width	Flat Length		Flat Width	Flat Length
30"x3"	7½"	94"	32"x4½"	11"	107"
30"x3½"	8¾"	97"	33"x4½"	11"	109"
32"x3½"	8¾"	108"	34"x4½"	11"	112"
31"x4"	10½"	100"	35"x4½"	11"	114"
32"x4"	10½"	105"	36"x4½"	11"	118"
33"x4"	10½"	108"	35"x5"	12½"	116"
34"x4"	10½"	110"	37"x5"	12½"	121"

Length measurement allows for approximately 6 inches lap at splice; slight trimming can be made on width.

TIRE PAINT

Appearance is essential in returning tires to the owner, both for even finish on the repair and also in relation to color of gums. A few minutes used in painting both the inside and outside of the casing with a good tire paint will add to the owner's approval of the work. This paint should be applied to the complete tire and not in spots. Colors should be kept on hand to match the gums or colors used on the tire. The following will make a good white tire paint and can be shaded as required.

Coarse Para Rubber	4 lbs.
Lithophone	15 lbs.
Mica	15 lbs.
Zinc	6 lbs.

Use gasoline as a solvent, mixing compounds first. By adding more rubber, greater adhesiveness can be secured.

After mixing the original white formula, it is only necessary to add small quantities of pigments that mix with gasoline to secure the proper color. These colors usually meet all requirements for a good non-smutable paint.

CHAPTER XIII

BUSINESS METHODS

To the repairman venturing into business for himself, a few words should be said regarding starting and conducting his work in order to build up an established trade that will insure a steady volume of work and customers. It is better to start alone on small capital, rather than in partnership, unless all parties are experienced in the business.

The location should preferably be on a main automobile road or street and easy of access. Drive-in facilities should be provided if possible to allow winter changes and service. The appearance should be good, with window display for stock and repair work.

The store should be kept in a neat condition, arranged orderly at all times and with the repair shop separate from the store. In the store should be found only the finished article ready for the customer.

The display windows should be changed regularly and should contain such items as are in seasonal demand or special articles noticeable by the user. Displays that will cause comment are a good medium of advertising. Tires, accessories or good specimen repairs should always be found in the display window.

A good tire should be selected for the use of your customers, as it is on this grade that your future

business will be built up, not on seconds or blemished goods. Always aim to sell an article that is serviceable in order to have return customers. Sizes should always be carried and a parent stock be kept on hand at all times, especially during the driving season. This stock should be replenished before completely sold out.

Should your customer demand cheap tires, such as seconds, do not hesitate to tell him what may generally be expected from such articles. In this way you will establish yourself in the eyes of your trade as conducting a square business, which is essential for any success.

So-called "second" or "unguaranteed" tires are not ordinarily carried by reliable shops, as the mere fact that they are not fit to carry the guarantee should be evidence that they are not expected to deliver good mileage. It is not good policy to guarantee seconds, as this has caused the failure of many stores. Every effort should be used to keep the stock moving and to sell stock before it has been on the shelf very long.

Sell your own tires and know them. There are other good tires made, so the sucscessful tire man will under no consideration criticise other makes or misrepresent them when he knows them to be good. Aim to get the business, in fact, under present-day competition, the volume is best secured by going out after it. Do not wait for it to come to your door. It is a known fact that the owner of the tire store can best secure outside business, unless he employs a salesman fully experienced in getting outside business.

In making sales, do so at a profit in every case.

Good tires, work and salesmanship do not need a discount to every car owner in order to sell goods. The habit of cutting prices was the cause of the manufacturers largely decreasing the dealer's margin of profit in late years. Every time you reduce your price you acknowledge inferior quality. It is business suicide to sacrifice profit for volume.

Careful attention should be given to prospective buyers in a card record. This should be regularly followed up. Repetition of business calls must bring results.

When financially able, a supply of the necessary tire accessories of good quality should be stocked and well displayed. This might include such articles as cement tubes, pumps, boots, flaps, patches, plasters, gauges, talc, chains, jacks, cores, caps, tools, reliners and tire covers, all in quantity to meet the seasonal demand. Make the store specialize in the tire and rubber line if possible. Some stores make a success of carrying auto accessories; however, this should depend on the demand.

Only the best of repair work, with expert workmanship and the best quality of material should be used. The customer will pay for good, serviceable repairs in all cases, when he finds that they hold up and deliver the mileage. It takes only a short time for tire owners to find that repair work is of poor quality. The appearance of the work should be correct and uniform with the tire itself. It is the appearance of work that first meets with the approval or disapproval of the user. Rough, bulging work, or improperly matched colors, should never be sent out of the shop.

A good tire man will, regardless of who is at fault, always be patient with the customer when adjustments are requested or complaints come up. Whether or not an adjustment is made or is forthcoming, it is not good business to antagonize the owner. In most cases the customer may know he is wrong and must recognize a reasonable explanation unless some foolish guarantee or promise was previously made. The tire man must recognize the fact that he is not infallible and must use his experience to show the trouble. If at fault, admit it, and stand back of it, especially on repair work.

The best method of conducting a business is on a cash basis. Repairs should always be cash, unless the customer has daily work. There is no reason for opening a book account for small amounts. Tire repairs, to the average car owner, are like gasoline which might be of good quality; but, when burnt up, he does not like to be bothered about it. In large towns a reliable rating association should be connected with.

Service, whether free or not, is an asset that goes with every well conducted shop. This term does not necessarily mean that work such as changes and inflation should be done for nothing and with no means of return. Such service, when given free, either at the shop or on the road, and when done in a workmanlike manner, should merit the return of a tire user's business. Some shops have service cars that inflate tires, make changes and take tires and repairs to their customers on the road, and which also pick up repair work.

Whether at the shop or not, the work should be

done quickly, and above all, pleasantly. A grouchy workman should never come in contact with your trade. The employees should be kept on their toes all the time in caring for the trade and in getting new business. The owner will quickly get the spirit and appreciate it. If you advertise service, be prepared to give it at all times. If it is not good, do not use it.

Should you employ men, secure such as have ability to please your trade. When a man is productive, see that he is properly taken care of in salary. If he cannot produce, dispense with him. All persons connected with your business must be honest with each other and also with the public. Employees who are dishonest with one another will be dishonest with you, and if they lie, look out for them. At all times manage your own business.

Adjustments on tires or repairs should be made in a manner that will convince an owner that you are pleased to have him bring the article in. If the customer is at fault, tell him so in an agreeable manner. After you have done this, you can still make a replacement repair, either at a charge to cover material and labor, or free if poor workmanship should show up. Defective material should be no excuse for the repairman, for cheap stock should not be used. It should be remembered that the guarantee on a repair should be similar to a new tire guarantee, namely; that underinflation, overloading, bruises, running flat and chain abuse will affect the life of a repair quicker than they will a new tire and that a shop cannot be expected to do work over without charge when made necessary by abuse. How-

ever, these causes should be explained to all customers when they call for their work.

Air should be provided for free use to the trade at all times, both in the shop and at the curb. A high pressure should be kept up. Some shops provide a man to handle this service on the street. With a knowledge of the business and with proper attention and courtesy, he can secure many tires for repair by bringing tire trouble to the owner's attention while doing his work. Charges should always be made for all cores, caps and small accessories used in this work.

A certain amount of advertising and publicity should be given the business at regular intervals in order to keep the store before the attention of the trade and for new business. This can be done in several ways, it resting mostly with the repair man as to the best advertising methods available. Signs should be placed on incoming roads, and also on the frontage and sides of the building. An attractive frontage and conspicuous colors will attract business and direct attention. A good method is to drop business cards, outlining the commodities handled, in all cars parked in a certain territory every day. Price lists should be provided and be distributed through mailing lists. Many ideas will present themselves that will be of benefit when the expense is not too great. A certain percentage of the income should be set aside for this work in proportion to the business handled, and it should at all times be kept up.

One of the most important things is that of taking advantage of cash discounts on payment of all monthly bills. Prompt payment should always be made. This will never be overlooked by the man who is

looking forward to a successful continuance of business. In turn, collections should also be followed up as soon as past due.

The overhead expense should always be kept within bounds. The quarters should not be larger than necessary for the business handled. While the percentage of profit in the repair trade is considerably larger than in many others, it must be remembered that it is in smaller amounts and there must be a larger volume of work to tide over the overhead expense for the whole year, some months of which are unproductive. The busy season in most localities is short, and it is during these months only that the profits must be made. During busy months, every effort should be made to secure both local work and shipments. If the repair work in an outside territory is unsatisfactory, some advertising should be started in that vicinity. Good competition will never cut down the volume of repair work and hundreds of repairs are available in every locality if the work is gone after.

Keep continuously in touch with your trade, meeting them personally and keeping your place of business for them. Should a good account be lost, it should be looked up and the reason for the change found out. If due to your work, prices, or your employees, it can no doubt be adjusted satisfactorily.

Changes in the business and trade should be noted at all times and no impression should be acquired that there is nothing further to be learned of the business, or that changes in business methods are not necessary. Tire types change annually, new accessories come on the market, and new repair

methods are likely to come up to which every attention must be given in order to keep the repairman at the head of the list and increase his efficiency. The object of this book is to supply a firm foundation for better development of this work, which, when mastered, easily makes room for the tire man's own ideas and others that may develop as the trade grows.

CHAPTER XIV

TIRE AND REPAIR SHOP GLOSSARY

The tire repair business and trade has, like any other, a term of expression to describe each part, operation or method of handling or performing certain work. It has been found that, in this trade, very few workmen have made a study of this important matter. They little realize that the opinion of a well informed tire owner, tire business man or repairman is formed from the application of the trade words to the business.

The proper application of a term or expression referring to an operation or transaction denotes knowledge, and is quickly noticed by the man who knows. In order that the new tire man, or even the workman with years of experience, may express himself correctly in regard to a transaction or operation, the following lists of words are arranged in the working order of the tire trade.

For correct definitions covering repairs, abuses, injuries, materials, types of tires, tire parts, and adjustments, the chapters covering these items should be referred to.

GENERAL TERMS

Abuse.—The improper care or use of a tire.

Adjustable.—Subject to adjustment for merit or policy reasons.

Adjuster.—One who decides whether a tire is adjustable or to be rejected. Estimates mileage, etc.

Adjustment.—Replacement of a tire found defective, or for policy reasons, at a cost for the estimated unrun mileage

Bias.—A 45 degree angle from the run of thread or grain. Relates to the cutting of fabric used in tires.

Blemished.—Relates to a tire marred during manufacture, or old stock, or obsolete.

Calender.—A machine with steam rolls for frictioning gums to fabric and for rolling gums to a required thickness.

Carcass.—The fabric body of the tire.

Compounds.—Drugs or materials added to rubber for wearing, curing, tempering and coloring purposes.

Consumer.—The ultimate user or buyer of a tire.

Curing.—An expression substituted for vulcanizing of rubber.

Dealer.—A seller or merchant of tires in small quantities, or in a small territory.

Defective.—Imperfect materials or workmanship in tire causing defects that put the tire out of service.

Distributor.—A seller or merchant of tires in large quantities with territory rights.

Dry Cure.—The vulcanization of rubber in a container in which wet steam does not touch the article.

Factory Branch.—A tire manufacturer's distributing house in certain territory.

Fillers.—Accessories such as blow-out patches, reliners, etc., placed in a tire.

Firsts.—A guaranteed tire.

Friction.—Cotton fabric calendered with frictioning material. Friction pull denotes tension required to pull plies apart after vulcanizing in the tire.

Guarantee.—The mileage basis assured by the manufacturer of a tire denoting that materials and workmanship are such as to warrant the tire running this mileage, if not abused knowingly or unknowingly.

Heavy Duty.—Large pneumatic tires used on trucks, etc.

Holland.—A thin cloth, coated with paraffine or starch, used for wrapping repair materials.

Imperfections.—Improper material or workmanship in a tire.

Inflation.—Placing of air in tube and case to the proper pressure.

Inspection—The examination of a tire for abuse, injury or defect.

Injury.—Abuse of tire knowingly or unknowingly. Part to be repaired.

Jobber.—Similar to distributor. A seller in large quantities.

Junk.—Condition of tire when useless for further service.

Kind.—Relates to tires being fabric, cord fabric or cable cord.

Laminated.—Curing of several plies of rubber together.

Load.—The amount of weight a tire is recommended to carry at the proper inflation.

Make.—Refers to the name of the manufacturer.

Merchandising.—The business of selling tires.

Merit.—Worthy of adjustment outside for policy reasons, defective.

Mileage.—The distance a tire has run or is guaranteed to run without abuse.

Mis-Used.—Improper care and treatment of tire while running.

Moulded.—A kind of tire vulcanized between two complete moulds which lock together, usually at top of tread.

Oversize.—Enlargement of the capacity of a tire ½ inch without increasing the diameter or circumference of the beads.

Parent Stock.—Consisting of a reasonable number of all sizes at all times.

Pigments.—Coloring compounds added to rubber.

Pneumatic.—Relates to use of compressed air in a tire.

Policy.—Method of making an adjustment when not entirely due to defect, or to way of conducting a business.

Rejected.—Refusal to adjust for any reason.

Reliner.—Filler used for reinforcing interior of tire to secure additional mileage.

Repairable.—Tire in such condition as to warrant repairs at a cost in comparison to mileage to be received.

Repairman.—One who repairs or vulcanizes tires.

Resilient.—Quick acting or full of life.

Second.—A tire not carrying any guarantee. Any tire without serial number or name is a second.

Serial Number.—Manufacturer's number branded on side of tire.

Serviceable.—A tire still in condition for mileage, either with or without repairs.

Size.—Relates to tire required for certain load. Measured through the diameter of the tire and tire cross section from bead to tread.

Skim Coated.—Coating of frictioning material calendered over frictioned surface to increase thickness. Gives better adhesion between fabrics.

Solvent.—A liquid used for cutting rubber for cement.

Specific Gravity.—Denotes the amount of compound in rubber. The higher the gravity the more compound, thereby being made heavier than water. The number 1 is taken as water. Any increase over 1 will sink; less than 1 will float.

Tensile.—Relating to the strength of fabrics used in tires. The amount of strain necessary to bring fabric to a breaking point.

Turnover.—The selling or cleaning up of a stock of merchandise.

Type.—Relates to bead construction of tires as "Clincher," "S. S." or "Q. D."

Unguaranteed.—A tire carrying no guarantee of mileage.

Vulcanizing.—The process of curing or changing rubber by means of heat into a compact, resilient condition.

Wet Cure.—The vulcanization of rubber in wet steam.

Wrapped Cure.—Process of vulcanizing a tire with side flanges only and by wrapping the entire tire in place of using complete moulds.

TERMS USED IN REPAIRING TUBES

Applying.—Refers to placing of valve pads, cold patches, and cementing of repairs.

Backing.—An operation of putting semi-cured gum through the hole or injury and up against the repair from the inside.

Beyond Repair.—Common expression denoting that a tube is out of service; being junk, due to running flat, or with nail holes in several places, making repairs unprofitable. Extreme blowouts and tears will also cause this condition.

Beveling.—To taper or trim, to feather the edges of injury.

Buffing.—The cleaning or roughing of all repairs or surfaces to which cement is to be applied.

Cementing.—Applying liquid gum for uniting of rubber (raw or cured).

Centering.—The placing of a valve pad in the middle of the tube, or the proper starting of a splice.

Covering.—The application of holland cloth over raw gum of a repair before putting on the tube plate. This prevents sticking and also makes smooth work.

Cracking.—Inside cracks or over-cured repairs.

Cutting Out.—An operation used on every repair for the removal of torn or rough edges and to allow for insertion of backing to holes. Also for cutting out sections of the tube.

Curing or Vulcanizing.—The application of the raw gum portion of the tube repair to the hot plate.

Edges.—Referring to the sides of the repair when properly cut away. All gum must have contact at the edges when filled.

Filling.—Placing of raw gum in strips in the hole or injury to fill up to the thickness of the tube; usually made higher in the center.

Folding.—Refers to turning the tube back over tube mandrel or to wrapping for delivery.

Grinding.—This operation is used in many shops in place of buffing the edges of holes. To bevel the edge to a feather point, which decreases the breaking chances of the repair. Otherwise the edge would act as a hinge. Spliced edges are also ground down.

Inserting.—Putting backing through holes in a tube, or placing of a valve in the tube or through the tube hole. Would also apply to placing the end of a splice inside the other end, and to putting in a valve core.

Loosening.—Prying away or opening splices and old patches; also to starting a rusty valve nut frozen on.

Patching.—A term used to denote application of cold patches, or cementless patches, khaki-back, etc. Refers also to air drying cement.

Porous.—A slow leaking condition of a tube, due to too much compound, deterioration, or abuse.

Pressure.—Applies to force exerted against the repair, either on the tube plate, in uniting gums with tools or by slightly inflating with air in the tubes. It is an absolute essential in curing tubes to see that the pressure is set evenly and of proper tension.

Pulling.—Refers to pulling the splice end over after fitting.

Reaming.—Valve repair by use of the valve tool on the threads in the valve.

Removing.—An operation of taking out a valve or a tube from the plate.

Replacing.—Putting back the valve or a pad in the same place.

Retapping.—Refers to use of a valve tool on the valve for resetting, smoothing, etc.

Rolling.—Operation of uniting gums or rubbers, used for removing air blisters and making a compact unit.

Rounding.—This is done in all repairs to remove chances of further breaking. It is for this reason that the split or end of the repair is rounded slightly.

Rubber Block.—Applied over the repair when on the plate to pocket the gum at the edges, while at the same time providing a yielding pressure as the gum softens. It is reinforced with a thin wood block to give the final surface.

Sealing.—Use of thin raw gum over the edges of a repair for binding purposes. Adds strength, and makes a smooth repair.

Shaping.—Adding air to tube for body when splicing. Manipulation of gums to shape.

Splicing.—The connecting or fitting of tube ends.

Splitting.—Used in reference to cutting the valve nut with a chisel when frozen on. A deteriorated tube which continues to break from inside cracks.

Stitching.—This operation is performed with a wheel roller to unite or weld gums to a unit; also used on fabrics.

Testing.—The inflating of a tube with air and placing under water in a tank to locate leaks.

Tying.—Application of two cords around a folded tube to keep if compact and orderly.

Uniting.—Operation of appiying gums together and pressing to a unit.

Washing.—This operation is performed on every repair by the application of a cloth dipped in gasoline to remove oil, grease, dirt, etc.

Wrapping.—When using a mandrel, the splice is wrapped with cloth or old tubing for pressure until the cement is dry.

CUTTING DOWN TERMS

Bead Core.—One of the parts of tire (center of bead) towards which operations lead in most all repairing.

Bead Cover.—An important fabric term that is encountered

in almost every repair. A chafing strip which covers and protects the beads.

Beyond Repair.—This expression denotes that a tire is junk and should not be repaired.

Blocking Out.—An operation of cutting out the ply to be removed on the top of the tire after the tread is laid back. Acts as a guide to the section. The steps in the repair are started in this manner.

Breaker.—A ply of tire fabric encountered whenever the tread is cut or removed.

Buffing.—An operation to remove dirt, old gums, etc. Used on every repair.

Center.—Denotes the middle of the tire on tread. Never cut a ply in the center, as a sharp knife-like edge is started.

Cleaning or Cleanliness.—By use of buffer or with scraper. The success of vulcanizing.

Cushion.—Part of a tire. A gum encountered in making tread laybacks.

Cutting.—Refers to all cutting of the tread or fabric in which any knife is used; in reality, splitting.

Dampness.—A wet condition which must be eliminated before repairs are attempted as it means friction if allowed to remain.

Deciding or Decision.—Arriving at a conclusion of what repair is required by a certain injury or for the condition found.

Dipping.—Refers to dipping knives in water to allow easier cutting or skiving.

Drying.—Placing of damp tires in warm places to eliminate all moisture.

Eliminating.—Action of removing all friction or injury.

Ending.—Refers to point at which a ply stops on or around the bead.

Exceptions.—Different methods of construction in tires which deviate from the regular run of repair work.

Fabric.—Encountered in all sectional repairs or inside work.

False Beads.—A bead applied to straight side tires when used for quick detachable type.

Feathering.—To taper fabric or gums on a slant to remove the hinge.

Friction.—Any substance that will cause heat or a loosening of the ply, such as water, dirt, glass, nails, etc.

Grinding.—Refers to the use of emery stone for removing or smoothing tread, or for sharpening knives.

Gauging.—The marking of a tire where the tread line is to be cut or replaced.

Heel of Bead.—A part of the bead farthest from the tube referred to in every sectional repair.

High Point.—The highest part of a non-skid tire. Splices are cut here to allow for accurate pressure when placed in the mould.

Injury.—The apparent reason why a tire went out of service and made the repair necessary. Must be entirely eliminated to give service that is lasting. Merely covering the injury without proper stepping and rounding does not remove the trouble.

Inspection.—Refers to looking a tire over for injury or defects to decide whether repairable, junk, or subject to adjustment.

Junk.—The condition of a tire not good for further service.

Layback, Single or Double.—Laying the tread back to expose the fabric in sectional repairs.

Locating Injury.—Usually the result of an inspection, definitely decided by probing with long probe for separated fabric and by pushing a fine awl through the tire to show where the break ends when placing a section. A break is most always longer on the inside of the tire than on the outside.

Loosen.—The prying of the fabric at ends of cuts for easy removal, or prying staples in cable cord tires.

Marking.—Done on outside of tread with indelible pencil to show start and end of splice. Side walls are also marked. An expert never uses a pencil on this, however.

Measuring.—Refers to measurement from injury to splice on a certain size tire. Steps may be measured but are estimated by most repairmen.

Mixing.—Refers to stirring of cements when used or made. Usually done in the cutting-down room. This should be done regularly to keep an even consistency.

Necessary Repairs.—The work and kinds of operations required to put a tire into either first class or temporary service.

Neck of Bead.—A part of the tire that enters into every-day work when cutting down above the bead or where the side wall ends. Sometimes called the channel.

Placing.—Refers to laying the tire on the work bench or shelf.

Ply.—The fabric which composes the carcass of the tire in layers.

Probing.—Inserting a long blade between the plies to locate loose fabric.

Salvage.—To repair a badly worn or abused tire and put back into service.

Rasping.—An operation of roughing or cleaning the tire or tread splices with a wood or rotary rasp.

Roughing.—Effect of proper rasping which opens the grain of the rubber or the strands of fabric to allow infusion of cement so that it adheres or rivets to another surface of the same kind when cured.

Rounding.—Refers to the cutting of a circular shape at the end of breaks.

Scraping.—Refers to use of knife or scraper for removing soapstone, dirt, oil, etc., from places not reached by a buffer. Some shops scrape all repairs in place of buffing. This, however, is tedious labor.

Sharpening.—Grinding or sliding knives on sandstone or emery.

Side Wall.—The side shell or carcass of the tire to which reference is made daily in cutting down.

Splice.—The cut made in the tread, either for sectional layback or the edges of tread when tread patches are cut. Should be at angle of 45 degrees to give proper adhesion. If cut too long, it will feather and loosen up; if straight, would pull apart from the road strain.

Spreading.—Forcing the tire apart at the beads and inserting a wood block so as to work inside.

Skiving.—Trimming of fabric to feather edges to take out ridges which would hinge and later start a break.

Slitting.—Or the cutting of fabric with a fabric or notched knife.

Stepping.—The cutting of fabric or plies in widths of scale measurements for removing in blocks.

Stripping.—Refers to the tearing away of parts of a tire from the main carcass or body.

Toe of Bead.—Part of tire nearest tube, referred to in all tire repair work.

Tread.—Outside cover of the tire, removed or laid back as the case may be.

Water.—Used for dipping knives to allow for the easy cutting of rubber.

Weak Fabric.—A condition caused from internal friction, wet, oily or dirty application, or by moisture or oil absorbing into the carcass of the tire through holes.

BUILDING UP TERMS

Applying.—Refers to placing of ply of fabric on a tire or repair, also to placing of gums and retread bands, side walls, side strips, etc.

Bias.—The 45 degree angle across the fabric; so cut to allow for the strain on the tire or carcass.

Blisters.—Pocketing or appearance of air bubbles between gums and fabric. Must be removed in all cases.

Bloom.—Appearance of free sulphur or rubber due to chemical action and exposure to light and air. Raw or cured gums will bloom. Wash with gasoline.

Building.—The act of constructing a tire. Refers to replacing the materials in a repair or applying fabric to core.

Butting.—Refers to placing bareback flat with ends against each other and stripping with cushion gum; also to fitting fabric when going over the bead.

Cleaning.—The proper washing of gums, etc.

Cutting.—Operation of cutting fabrics and gums in various sizes to fit a repair.

Exceptions.—Referring to tires of different construction.

Grinding.—This operation is done on the emery to smooth the outer surface of surplus gum. It might also refer to sharpening knives.

Gauging.—The marking of side lines on the carcass to fit the band, using bead as line.

Gum Stripping.—To insert or apply a narrow strip of cushion gum between over-laps.

Inspecting.—Referring to condition of cement and kind of work required.

Inserting.—Refers to placing of reinforcement or reliner; also to replacing staples in building up.

Lapping.—Applies to the width by which fabric overlap when connecting and also to the overlap of fabric and gums when applied to the repair, placing across or over points.

Loosening.—Usually refers to forcing back the surplus gum

when trimming. Applied to pulling plies apart. After once being stitched, plies should be recemented.

Measuring.—The marking of fabrics and gums to be cut or as required for use on a repair.

Non-Skid.—The raised or vacuum obstructions or indentures already on the tire tread, or to be made.

Perforating.—The punching of gums, or an entire repair, to remove air blisters or provide air vents while curing.

Prodding.—Forcing of gum into one place with small screw driver, either to fill up or to be trimmed.

Reinforcing.—To cover or build over or under a weak place.

Replacing.—Applies mostly to resetting cable cord staples.

Rolling.—Act of uniting gums or fabric under pressure with a roller.

Selvage.—The woven edges of fabrics which should always be cut off.

Shaping.—Forming of gums of a repair to a neat shape for curing and for appearance.

Smoothing.—The buffing or rasping of a repair to remove surplus materials.

Scrap.—The gum trimmings and fabric to be saved.

Spreading.—The insertion of blocks to keep tire open for inside work.

Stitching.—Operation of uniting fabrics and gums, especially in places where the roller will not touch.

Strapping.—The shaping of a tire to the mandrel by using scrap fabric so to hold section in place. Usually placed at the ends of the repair just outside the side wall cut and where cemented, in order to hold, yet not interfere with application of gums of fabrics.

Stretching.—Pulling of fabrics as they are being applied and stitched in order to take out slack.

Surplus.—Any gums that require trimming.

Trimming.—Operation of cutting away all surplus material; may be termed "smoothing."

Uniting.—Placing of raw and adhesive gums together by stitching or rolling.

Washing.—Use of gasoline and cloth to remove dirt, grease, bloom, etc., from gum and fabrics.

CURING AND STEAM TERMS

Applying.—Refers to placing pads, face cloths, or soapstone in a repair.

Blisters.—A porous condition of rubber after curing, due to insufficient pressure.

Blowing.—The expansion of a repair after cure, caused from moisture.

Blowing Off.—Refers to the opening of pet-cocks or drains to let out air and water.

Bringing-Up.—Increase steam slowly until a certain temperature or pressure is obtained.

Buckling.—The forming of a ridge or buckle inside the tire or along the side wall. Caused by too great a clamp pressure forcing the walls down to a ridge or buckles. Improper padding will also cause this condition.

Cementing.—Usually applies to applying patching cement when placing an impression pad. Patching cement loosens up with heat and can be taken off.

Circulation.—The free passing of hot steam through the moulds to give proper heat.

Clamping.—Using of clamp to hold bead moulds to tire, or applying pressure with mould clamp.

Cleaning.—Refers to sand-papering moulds. Generally done daily.

Containers.—Any receptacle for holding gums to a certain shape under pressure.

Covering.—Placing of cloth over a repair to stop burning. Called "heat cloth."

Curing.—The vulcanization of raw gums in tire repairs.

Grinding.—Done on the emery stone to take off high or rough spots when cured.

Dusting.—The shaking of soapstone or mica on repairs and moulds to prevent sticking.

Inserting.—The placing of a bag in tire.

Leaking.—Escape of air from bags or bad steam connections.

Measuring.—Taking the length or size of a repair.

Overcure.—Vulcanizing for too long a period or at too high a temperature, causing a hard or brittle condition of the gum or rubber.

Padding.—The placing of plies of fabric from old tires or, in some cases, using flaps at the bead to take up the space left from too small a bag.

Pet-Cocks.—A small valve used for allowing the escape of steam and water.

Pocketing.—The trapping of water or air in pipes or moulds, stopping circulation and heat.

Porous.—A soft or blistered condition of rubber, mostly due to improper pressure.

Pressure.—The application of force against the surfaces of a repair. It forms the materials to a solid unit. Must be exact in all rubber work.

Reducing.—Refers to pressure regulating valves, or time of cure.

Replace.—Applied mostly to putting tires back in mould when undercured or buckled.

Removing.—Covers the taking of tires from mould, or the coil from retreads.

Ridging.—Similar to buckling when the clamp is too tight. Also due to using too long an air bag which forces tires into the ends of moulds.

Set-Up.—The operation of making a tire ready to go into the mould or kettle by using bag, pad, bead moulds, impression pad, etc.

Smoothing.—The finishing of a repair by grinding or rasping to remove high spots and surplus rubber.

Surplus.—Appearance of gum over-flow on a repair.

Tapping.—Refers to lightly hitting a sticking bead mould with a rubber mallet.

Temperature.—The degree of heat in steam required for curing.

Test.—Forcing a sharp object into the tire to learn of an under- or over-cure of the gum.

Time.—The length of a cure required for vulcanization of material in a repair.

Trapping.—Refers to water which is clogging and stopping the circulation of steam.

Trimming.—Removing all surplus rubber from a repair.

Under-Cure.—Due to insufficient vulcanization causing a soft condition of the gum.

Vacuum.—A condition caused by steam equalizing and stopping complete circulation. Open pet-cocks to remedy.

Wrapping.—The winding of strips of cloth about a retread for pressure.

CHANGING AND SERVICE TERMS

Applying.—Refers to placing case on rim, also to putting rim on wheel.

Centering.—The placing of a tube in case with flap properly set in under the beads.

Changing.—Term used in replacing or re-arranging tires, tubes, or rims.

Emergency.—In temporary service, the setting up of an old case with blowout patch, lace-on boot or otherwise.

Inserting.—Placing of tube in case or putting in new valve core.

Forcing.—The pressing of a tire onto the rim or the rim onto a wheel when tight.

Inflating.—Putting air in tires to proper pressure.

Loosening.—Refers to removing rim plate, locking devices or lock rings, also to tapping rim from wheel when stuck.

Lubricating.—The application of soapstone, talc or mica in small quantities in the case to keep tube from sticking. Never use too much.

Pinching.—The squeezing of the tube against the rim or bead of case when applying a clincher. Cases of improper insertion in case on other tires. The flap poorly inserted will cause the same trouble.

Pressure.—The number of pounds of air carried by a tire.

Protect.—Referring to improper applying of tubes without flaps or to using rims with holes from lost lugs which allow blowing out the tube. Also to covering breaks, etc.

Raising.—Application of a jack under the axle or spindle to elevate the wheel from ground.

Removing.—Taking a rim from the wheel, a case from the rim or a tube from the case; also to taking extra from tire holders on car.

Soap-Stoning.—Same as lubricating.

Tapping.—Or hammering the rim to remove when stuck, and to remove rim parts. Also to apply tire on the rim and rim on the wheel.

Testing.—The gauging of tire inflation to the proper number of pounds of air.

Set-Up.—The complete assembly of a tire unit ready for use.

CHAPTER XV

TRADE DIRECTORY

TIRE COMPANIES

Showing commodities handled or manufactured. Refer to numbers opposite to show following lines handled or class of business.

1. Factory branches in large cities in various states.
2. Dealers, distributors or dealers in large cities in various states.
3. Manufacturers of solid tires.
4. Repair materials.
5. Tire accessories.
6. Repair tools.
7. Equipment.
8. Boots or raincoats.
9. Mechanical mould goods.

	Fabric Tires	Cord Fabric Tires	Cable Cord Tires	Tubes	Other Commodities
Acme Rubber Co., Trenton, N. J.	*	*	*	*	9
Ajax Rubber Co., Inc., Trenton, N. J.	*	*	*	*	1-2-4-5
Amazon Rubber Co., Akron, Ohio	*	*		*	2-4-5
American Rubber & Tire Co., Akron, Ohio	*	*		*	2-4-5

	Fabric Tires	Cord Fabric Tires	Cable Cord Tires	Tubes	Other Commodities
Archer Cord Tire Co., Minneapolis, Minn ..	*			*	2
Armstrong Rubber Co., Garfield, N. J........	*	*		*	2
Batavia Rubber Co., Batavia, N. Y..........	*			*	
Beacon Tire Co., Beacon, N. J............	*			*	2
Bergougnan Tire Co., New York City......	*			*	
Boone Tire & Rubber Co., Sycamore, Ill....	*			*	2-4-9
Braender Rubber Tire Co., Rutherford, N. J.	*	*		*	1-2-4-5-9
Brunswick Balke Collender Co., Chicago, Ill.	*			*	1-3-9
Bucyrus Rubber Co., Bucyrus, O.	*	*		*	
Carlisle Tire & Rubber Co., Carlisle, Penn...	*		*	*	
Century Plainfield Tire Co., Plainfield, N. J..	*			*	2-3
Columbia Tire & Rubber Co., Columbia, O..	*			*	2
Continental Rubber Works, Erie Pa.	*			*	1-2-4-5-9
Converse Rubber Shoe Co., Malden, Mass....	*			*	2
Curtis Tire & Rubber Co., Muskegon, Mich.	*			*	2-3-9
Delion Tire & Rubber Co., Trenton, N. J....	*			*	2
Diamond Rubber Co., Akron, Ohio	*	*		*	2-4-5
Double Fabric Tire Co., Auburn, Ind.	*	*		*	2-5

	Fabric Tires	Cord Fabric Tires	Cable Cord Tires	Tubes	Other Commodities
Dreadnaught Tire & Rubber Co., Baltimore, Md.	*			*	
Dry Climate Tire Mfg. Co., Awada, Cal.....	*			*	2
Dural Rubber Corp., Flemington, N. J....				*	1-9
East Palestine Rubber Co., East Palestine, O.	*			*	2
Empire Rubber & Tire Co., Trenton, N. J...	*			*	9
Falls Rubber Co., Cuyahoga Falls, Ohio.....	*	*		*	2
Federal Rubber Co. of Ill., Cudahy, Wis....	*	*		*	1-2-4-5-9
Firestone Tire & Rubber Co., Akron, Ohio.	*	*		*	1-2-3-4-5-6-7-9
Fisk Rubber Co. of N. Y., Chicopee Falls...	*	*		*	1-2-3-4-5-6-7
G. & J. Tire Co., New York City	*	*		*	
General Tire & Rubber Co., Akron, Ohio....	*	*		*	2-3-4-5-6-7
Gillette Rubber Co., Eau Claire, Wis.....	*	*		*	1-3-8
Globe Rubber Mfg. Co., Trenton, N. J.......	*			*	
Goodrich Rubber Co., B. F., Akron, Ohio.....	*	*	*	*	1-3-4-5-6-7-8-boots-9
Goodyear Tire & Rubber Co., Akron, Ohio.	*	*		*	1-2-3-4-5-8 boots-9
Gordon Tire & Rubber Co., Canton, Ohio....	*	*		*	2
Hamilton Rubber Mfg. Co., Trenton, N. J...				*	9

	Fabric Tires	Cord Fabric Tires	Cable Cord Tires	Tubes	Other Commodities
Haynes Rubber Co., Winston & Salem, N. C.	*				2
Hardman Tire & Rubber Co., New Brunswick, N. J...........	*			*	
Hartford Rubber Works Co., Hartford, Conn..	*	*		*	2
Hawkeye Rubber Co., Des Moines, Iowa....	*			*	2
Hendrie Rubber Co., Torrance, Cal.	*			*	
Hood Tire Co., Corp., Watertown, Mass. ..	*			*	2-3-4-7-boots
Howe Rubber Co., Inc., New Brunswick, N. Y.	*			*	1-4-5
India Tire & Rubber Co., Akron, Ohio....	*	*		*	
International India Rubber Corp., South Bend, Ind.	*			*	1
Kelley-Springfield Tire Co., Cleveland, Ohio..	*	*		*	2-3
Knight Tire & Rubber Co., Canton, Ohio....	*	*		*	
Kokomo Rubber Co., Kokomo, Ind.	*			*	2-3-4
Lancaster Tire & Rubber Co., Columbus, O.	*			*	
Lee Tire & Rubber Co. of N. Y., Inc., Conshohocken, Pa.	*	*		*	2-4-5
Liberty Tire & Rubber Co., Green Bay, Wis..	*	*		*	2-5
McCreary Tire & Rubber Co., Indiana, Pa..	*			*	2
McGraw Tire & Rubber Co., East Palestine, O.	*	*		*	1-2-3

	Fabric Tires	Cord Fabric Tires	Cable Cord Tires	Tubes	Other Commodities
Mansfield Tire & Rubber Co., Mansfield, O.	*			*	2
Marathon Tire & Rubber Co., Cuyugha, O..	*	*		*	2-4-5
Mason Tire & Rubber Co., Kent, Ohio......	*	*		*	2-3-4-8 Raincoats
Michelin Tire Co., Milltown, N. J..........	*	*		*	1-4-5
Miller Rubber Co., Akron, Ohio	*	*		*	1-3-4-5
Mohawk Rubber Co., Akron, Ohio	*	*		*	1-2-4-5
National Rubber Co., E. Palestine, Ohio	*			*	2
Nebraska Tire & Rubber Co., Omaha, Neb......	*				2
Needham Tire Co., Charles River, Mass.	*				2
New Castle Tire Co., Makingtown, Pa.	*				2
Norwalk Tire & Rubber Co., Norwalk, Conn...	*	*		*	2
Ohio Tire & Rubber Co., Mansfield, Ohio	*			*	
Peerless Tire & Rubber Co., Green Bay, Wis..	*			*	2-5
Pennsylvania Rubber Co., Jeanette, Pa.....	*			*	9
Pharis Tire & Rubber Co., Newark, Ohio...	*			*	2
Polack Tire & Rubber Co., Bridgeport, Conn.					1-3
Portage Rubber Co., Barberton, Ohio.....	*	*		*	1-2-4-5-9
Quaker City Rubber Co., Wissinoming, Pa. ...	*			*	1-2-9
Racine Auto Tire Co.,					

	Fabric Tires	Cord Fabric Tires	Cable Cord Tires	Tubes	Other Commodities
Racine, Wis.	*	*		*	2-4-5
Racine Rubber Co., Racine, Wis.	*	*		*	2-4-5-8-9
Republic Rubber Co., Youngstown, Ohio ..	*	*		*	1-3-8-9
Revere Rubber Co., New York City	*	*		*	
Samson Rubber Corp., Compton, Cal.	*			*	4
Smith Tire Co., Utica, N. Y.	*			*	2
Standard Four Tire Co., Keokuk, Iowa	*			*	2
Star Rubber Co., Akron, Ohio	*			*	2
Sterling Tire Corp., Rutherford, N. J....	*	*		*	1-3
Swinehart Tire & Rubber Co., Akron, Ohio.	*	*		*	2-3
Ten Broeck Tire Co., Louisville, Ky.	*	*		*	2-3
United States Tire Co., New York City......	*	*		*	1-2-3-4-5-7-8-9
Victor Rubber Co., Springfield, Ohio	*			*	1-3
Vulcan Rubber Co., Oril Pa.	*			*	2-3
Woodward Mfg. Corps., Niagara Falls, N. Y..	*			*	

VULCANIZING EQUIPMENT COMPANIES,

SHOWING COMMODITIES MADE OR CARRIED.

Akron Rubber Mould & Mach. Co., Akron, Ohio.	Moulds, en bloc and single, for gas boilers, oil burners, large boilers, bead moulds, reducing shells, force feed system, tube plates, inside arms, retread moulds, en bloc, patch vulcanizers, retread kettle, coil boiler, gas

boiler, gasoline burners, pressure regulating valves, retread coils, tire rollers, mandrels, buffers, compressors, air tanks, rotary rasps, splicing mandrels, gas controller, tube deflater, repair tools, bicycle tire vulcanizer, inch and up. (Mould capacity all measures ¾ inch ending, taking the one-half and next full size, mould sizes range from 2½ to 10 inches.) Air bag system on sectional vulcanizers.

Anderson Steam Vulcan. Co., Indianapolis, Ind..	Two cavity portable outfit, gasoline burner, two place attached sizes cured from 3 inches to 5½ inches. Block system.
Arthur Vulcanizing Mach. Co., Warren, Ohio	Boot vulcanizer to which moulds from 3 inches to 5 inches can be added, combination plant, tools, etc. Air bag system.
Auto Tire and Vulcanizing Co., Lowell, Mass....	Moulds en bloc and single, for portable coil boilers, gas burners and large boilers, bead moulds, bead spacers, reducing shell, tube plates, retread moulds (single), patch vulcanizers, kettles (three sizes), gasoline burners, pressure regulating valves, retread coils, tire roller, building mandrels, blocks and cores, buffers, grinders, compressors, air tank, rotary rasps, splicing mandrels, gas controller, repair tools. (Moulds measure in ¼-inch sizes, taking next even half size tire to 8 inches.) Air bag system.
Craft Vulcanizing Co., St. Paul, Minn.	Five mould en bloc system, bead mould, "C" clamp, takes each size tire singly from three to five inches, tube plate, building mandrels, and tools. Air bag system.
Miller, Chas. E. (Anderson Rubber Works), Anderson, Ind.....	Moulds, en bloc and single, portable to use with either gas burner, oil burner or large boiler, bead mould, force bead system, tube plate, inside

	arms, retread moulds en bloc and single, patch vulcanizers, side wall vulcanizers, retread kettle (three sizes), coil boiler, gas burner, gasoline burner, large boilers, pressure regulating valves, force feed pump, retread coils, tire rollers, building mandrels, blocks and cores, buffer, grinder, compressors, rotary rasps, splicing mandrels, gas controller, tube deflator, boot vulcanizer, repair tools and bicycle tire vulcanizers, inch and up. (Moulds range from 3 to 7 inch tires. The cross measurement of moulds found in ¼, ½ and ¾ inch sizes.) Air bag system.
Shaler Co., C. A., Waupon, Wis....	Inside arms, patch vulcanizer, building mandrels, repair tools for use on wrapped system.
Superior Vulcanizing Co., Rochester, N. Y........	Single moulds for gas burner, tube plate, gas or gasoline burner. (Sizes in three moulds for 3 inch, 3½ and 4, and 4½ and 5). Block system.
Tire Repair Equipment Co., Appleton, Wis........	Single moulds for gas burner and large boiler bead moulds, tube plates, single retread moulds, patch and side wall vulcanizers, gas burners, gasoline burners, tire rollers, buffers, grinders, rotary rasps and repair tools. Moulds cure from 1½ to 6 inches. Solid pad system.
Vanderpoll Company, Springfield, Ohio	Portable moulds on frame, bead moulds, gas or gasoline burners, tube plates, single retread moulds, inside arms, grinders, compressors, rotary rasps, building mandrels, and tools. (Moulds measure ¾-inch ending, taking half and next even size, range from 2½ to 5-inch tires.) Air bag system.
Western Tire & Rubber Works, Chicago, Ill.....	One-third circle retreading mould for use on oil burner, gas burner. Dry cure sand bag method and special aluminum matrix for non-skid designs.

	Two sizes, made to take tires from 3 to 5 inches. Moulds, boilers, tools, etc.
Williams Foundry & Machine Co., Akron, Ohio.....	Cavities, single and en bloc for oil and gas burners or large boiler use, bead moulds, spacers, reducing shells, force feed system, tube plates, inside arms, retread moulds, patch vulcanizers, retread kettles in three sizes, oil burners, gas burners, large boilers for coal or gas, steam traps, pressure regulating valves, retread rims, rings and coils, force-feed pump, tire rollers, building mandrels, blocks and cores, buffers, grinders, compressors, air tanks, rotary rasps, splicing mandrels, gas controllers, tube deflaters, repair tools and miscellaneous equipments. (Mould capacities all measure ¾-inch ending, taking ½ and ¼ inch size; mould sizes range from bicycle tires to 10-inch heavy duty. Air bag system on sectional cavities. Sand bag, dry cure system on retreader.)
Zweebell Retreading Co., Milwaukee, Wis........	One-third circle retreading moulds en bloc or single from 2½ to 5 inch tires, gasoline burner, dry cure sand bag method.

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